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PROFIT MAKING

IN

SHOP AND FACTORY MANAGEMENT

BY

CHARLES U. CARPENTER

NEW YORK
THE ENGINEERING MAGAZINE
1908

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PREFACE.

"Profit Making in Shop and Factory Management" is a concise expression of the methods which Mr. Carpenter has developed and which he constantly uses in his own practice. They have been tried and perfected under the stress of daily operation in the course of his experience as supervisor, manager, head of the labor department, and president, of various large manufacturing plants, notably the National Cash Register Company and the Herring-Hall-Marvin Safe Company, of which latter concern he is now chief executive.

The contents of the book appeared first in the form of a series of articles, prepared for and published in The Engineering Magazine during the year 1907. As now presented in this volume, they have been carefully revised, in some points enlarged, to a certain extent rearranged, and a modified division into chapters has been introduced. These alterations however are only in details, adapting more effectively to permanent form the sections which were produced serially, and grouping them most advantageously from the closer perspective which is given to the reader of a book. The subject matter is unchanged in substance, and is even more complete than when it was first printed in the Magazine.

The study of works-management methods will be found to be marked throughout by the clear sight, the fair mind, the direct dealing, and the strong vitality of the author. The whole treatment is vibrant with life, the work indeed having been produced amid the incessant and insistent claims of active work in the management of the great manufacturing company of which he is president and manager. It is inspired by his keen interest in the promotion of better ideals in industrial organization. It is largely a labor of love, freely devoted to the advance of the profession of industrial engineering. And it bears throughout the stamp of tried, practical success.

THE EDITOR.

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PROFIT MAKING IN SHOP AND FACTORY MANAGEMENT

Chapter I.

THE REORGANIZATION OF A RUN-DOWN CONCERN.

IN the day of prosperity, when manufacturers are behind their orders, running full forces night and day, straining every nerve to increase production and are further embarrassed by a constant influx of new business, the consideration of the problems confronting a "run-down" concern and the ways and means of correcting its serious defects in organization, methods, and systems might not, upon first thought, appear "timely."

I contend, however, that the present is the time to attack and solve these problems. Experience and investigation have disclosed an amazing number of concerns which, even under prosperous conditions, have been having none too easy a time in making headway. Many manufacturers today have an uncomfortable sensation of uncertainty concerning the progress and profits of the establishments under their management.

Any manufacturer feeling the existence of unsatisfactory and unprofitable conditions must make up his mind that the real reasons for them must be discovered and the causes removed at any cost; for should the management, in its conduct of the business, not discover its weaknesses, this same management may be sure that some thoroughly organized competitor will drive the condition to their startled attention when more severe seasons of trade come upon us.

Necessity for Analysis.

To solve the problems confronting him, a man must bring to them an absolutely unbiased mind and a determination to analyze the situation thoroughly and mercilessly, and so to form an accurate judgment as to the underlying reasons. You, the manufacturer, may be sure that unless your factory, selling, and executive organizations can stand this test of your coldest and most searching examination—your analytical test—with any change from expanding conditions of trade, you will find the foundation of your business slipping from under it, slowly perhaps, but surely.

Advantageous Position of a Well Organized Concern.

We hear much today of the advantages that one competitor secures over another through the "secret rebate," special "shipping privileges," unfair "rate classifications," "secret agreements," etc. In a manufacturing business these advantages count for little against a company with an effective organization of the working force, stimulated by a desire to work not only for self but also for the good of the concern, aided by up-to-date mechanical methods and modern tools especially adapted to the quick, accurate, and economical manufacture of the parts to be produced; supported by comprehensive, though simple, systems that enable the management to keep an accurate check upon the cost of production, and also enable them to determine the proper course to pursue in order to secure still greater economies—a system of manufacture that enables the management to feel certain that the most economical methods of production are being planned and pursued.

Add to this an efficient selling force, properly trained by modern methods, and an economical plan of putting the manufactured goods upon the market, and the firm possessing such advantages is in an impregnable position.

The Manufacturer "With His Eyes Closed."

In this day, a firm which would hold its own, must adopt the most modern methods in organization, method, and system. Reputation gained in the earlier days of a firm's existence is a valuable asset when backed up by modern methods, but amounts to little when it is coupled with obsolete ways of doing business. A business must progress or slide backward. It cannot stand still. The manufacturer can always feel certain that if he is not progressing some one of his competitors surely is. This he may learn to his sorrow. The old maxim "a stern chase is a long one" applies with peculiar force to business conditions. Once your competitor has built his tools for economical production, improved his product, organized his forces, and secured the proper start on the market, his sales and profits multiply and yours decrease. And the longer you delay adopting similar methods, the more the difficulties increase.

There are still many manufacturers who are not satisfied to give their unqualified approval to modern methods in shop and selling organization. The number is growing less every day, but there are thousands to whom these remarks yet apply. To these the very word "organization" implies something mysterious—something big, and certainly something expensive. The idea of "organization" is not compatible with their idea of economical management. To these the idea of "system" is indissolubly linked with "red tape." "System" to them means additions to their clerical force, and additions to their clerical force means additional dollars spent upon "non-producers." They will refuse to admit the advisability of systems sufficient to care for their heavy factory interests, and yet they have sufficient intelligence to keep up their general accounting system. In brief, they do not note the tremendous leaks in their factories because they have not sufficient experience or data to enable them to know, with any degree of exactness, whether or not they are getting proper and economical results from either foremen, men, or machinery. A moment's thought must make such as these

realize the possibilities of the existence of such leaks, and they may be absolutely certain that where such possibilities exist, unchecked and unsystematized, there also exist the losses.

The Manufacturer "With His Hands Tied."

There are, however, many manufacturers on the other hand who realize that something is wrong, seriously wrong, and who would be glad to adopt modern methods if they but knew what they were and how to apply them. But to many a man who is intent on improving conditions, but who necessarily faces ignorance, prejudice, false pride, and stubbornness on the part of those in his organization who should help him, the job is appalling. To such, however, as recognize the conditions and are willing to attack the problem, methods can be suggested, the value of which has been proven over and over in actual experience under the most distressing conditions. Careful investigations, coupled with a thorough campaign of action along organized lines, will bring the reward.

The Reward.

The reward for such investigation, coupled with vigorous, intelligent, and tactful action, is so great as to justify the expenditure of any amount of labor and time. That it will take time, and in most cases a long time, is very true; but that is all the more reason for beginning and continuing courageously along steady lines of progress, and in such a manner that any backward step would not be be possible. The most difficult and discouraging problem to contend with, next to the difficulty of wheeling the old men into line, is that of progressing along new lines, devising and putting into effect new methods and new processes and tools, and at the same time not interfering with the regular required output. However, if the manager is sufficiently impressed by stern necessity to lay out plans for improvement, every one upon whom he must depend must be impressed with the idea that *every day* must show *some progress*, however slight, on the part of every one connected with the plans.

Organizing the Method of Investigation and Analysis.

As stated before, nothing can be done in any case until the manufacturer, and such advisers as are qualified and trustworthy, approach the problem in an absolutely unbiased frame of mind. They must make up their minds to analyze coldly each and every man and situation. The problem may be attacked as outlined hereinafter.

Let us consider first the usual defects in organization, system, and methods, in their order, and attempt to discover the "sticking points" in each division. They may be classified as follows:—

1.—Defects of factory organization, dealing with the superintendent, the foremen, the job bosses, and the workmen, and the usual methods of management.

2.—Defects of systems and methods of manufacturing.

3.—Defects of sales organization and executive control.

The separations made here are important ones and should be considered as thoroughly in the case of the concern with fifty men as in the case of the one with five thousand.

If you are interested, take these divisions item by item and make a faithful memorandum of the defects under each heading that you alone know of. If you have such a knowledge of the business as you should have you will be surprised at the number of your notations. Then when you come to the headings of those processes with which you are not familiar, secure the advice of competent persons in each line and observe the extent and character of your notes.

I. Defects of Factory Organization.

The Superintendent.

Singularly enough, the method of management usually adopted is that of placing all the responsibility on the shoulders of one superintendent and failing to surround and strengthen him with a small

body of the most efficient foremen, who might prove to be advisers of great value to him. In adopting such a method, the management fails to recognize the great benefit to be derived from securing the best advice of a small group of the best qualified men upon most important subjects, and from giving its foremen an opportunity to increase their knowledge of the business and so to grow to be of greater worth to the concern. The stimulus to the ambition of the foremen because of the opportunity so to show their worth is thus lost. Instead of these men being moved by the hearty desire to co-operate with the firm and with each other "for the good of the company," they are usually impelled by feelings of jealousy and impair the efficiency of themselves and the entire organization by their backbiting and faultfinding.

And yet with any method of organization there must be a head and a strong one. A "cheap" superintendent is dear at any price. A strong and capable man in this position is usually worth any reasonable amount necessary to secure or retain him. A large manufacturer once said: "My $20,000 superintendent is the cheapest man I have." In reply to the expected "Why?" he said: "He's my 'dividend maker.' I tried 'em at $3,000, $5,000, $10,000, only to keep on losing. Finally, I made up my mind I wouldn't pay less than $20,000—got my man, and he's bringing my dividends. Cheap at $20,000."

The Foremen.

The most important men in the shop. You may have the best qualified superintendent, but if you have inefficient foremen, you have poor management; you may have the best machinery—but with inefficient foremen, poor results; the best systems—complication; the best desires toward your workmen—your poor foremen bring upon you labor troubles galore.

When one stops to consider that these are the men who come into daily touch with your workmen—that they practically control the shop life and shop destinies of your men on machines and bench—

that to them falls the responsibility of getting the best results from the workmen, and upon their knowledge you must depend when it comes to the question of getting the proper and best results from the machinery you have bought—is it not absolutely true that they *are* the most important men in the shop, and that their methods, their intelligence, their experience, are questions most vital to you and your business?

Usual Methods of Appointment and Development.—And yet what are the facts in many cases? The foreman is often a former machine hand promoted to this position because of superior intelligence, diligence, and desire to please. This man, who should have a wide and thorough experience in modern machine practice, is often simply a graduate of your own shop, with experience limited to your routine practice.

The Proper Type.—The foreman should have a thorough knowledge of the best mechanical processes and the types of machines best suited for the work he handles. He should have also a wide knowledge of the tools, such as jigs, milling fixtures, dies, etc., best adapted to his work, and of methods of using them so as to procure the greatest economy in production; and, last but not least, the ability to handle men and get the best from them. Am I setting too high a standard for the foreman? I say No! positively No! These are the men who can "make or break" the concern. As is the foreman, so is the department. In nine cases out of ten, he is your "Sticking Point," or is responsible for it, be it poor workmanship, high costs, tardy production, or trouble with your workmen. This is as true of the small shop as of the large one.

Therefore, select him with care, watch him and help him, educate him, and, above all, give him the stimulus of "his chance" and watch him grow, if he is the right kind.

True it is that in the most modern shops the tendency now is to depend less and less upon the foremen on the important questions of speed of machines, types of tools, setting of standard time, and

proper prices on jobs. The best practice in the up-to-date shop is to institute speed bosses, rate-making departments, and tool and tool-designing departments, entirely independent of the foremen. In fact, as will be brought out later, such plans, properly instituted and carried out, will accomplish wonders; but this course is rendered necessary because of the weakness of the ordinary foremen. But in most shops it is hardly possible to consider such elaborate, though extremely valuable plans amongst the first steps. Depend upon your foremen you must. Even though the greater plan of organization with speed bosses, rate-making departments, etc., may be determined upon, this consideration of the foremen's efficiency is equally necessary. In fact, the broader plan will utterly fail unless it is supported by the intelligent efforts of the heads of departments.

The Management's Representatives.—Never forget that the foremen are *the management's direct representatives* to the workmen. The men form their opinion of the company from their opinion of their foremen. Their daily life and career are subject to his control, his whims and vagaries; their promotions and increases in pay depend upon his characteristics and knowledge. They more often have reason to depend upon his practice of favoritism than upon his sense of fairness. The character and ability of the foremen affect the workmen more directly than any other three factors in the shop organization and management, and as a consequence have a direct effect upon their output and disposition toward the company.

Job Bosses and Workmen.

In any shop organization, however small, the question of the proper division of the working force, so that the proper amount of supervision can be given to each man or group of men, must receive careful attention. A foreman cannot properly oversee his entire department without assistance and still give his attention to the larger and more important details of his work. The usual method

of securing this result is to appoint the more efficient members of the working force "job bosses" with some limited degree of authority over a small group of men. These men perform their share of the work, receiving a slight increase in their pay.

The importance of carefully selecting these men is at once apparent. They are usually the next in line for advancement to assistant foremanship. From these men come your heads of departments. And yet how many managers or shop superintendents possess accurate information concerning the character and ability of their job bosses? They usually promptly pass over to the foremen the responsibility for making these selections, and very often they in turn just as promptly pass the coveted position to some favored friend without much regard to the matter of his ability compared to that of the rest of the group affected—or, to drive the thought harder home—without regard to the ability and intelligence of the rest of the *candidates* for promotion. Advancement in wage and authority is as important to the $1.50 per day workman as it is to the superintendent. It is the neglect of just such points as these that cause workmen to feel that merit and hard work count for little, and that extra effort brings no reward in the face of an unfair foreman's selection of his friends and favorites for the only progress that is possible to them.

System of Pay and its Effect Upon Workmen.

Of equal importance in its direct effect upon men is the question of the "system of pay" and the method of handling it. Little will be said at this point regarding these matters. However, in considering the defects directly affecting the workmen and seriously affecting the cost of production in many forms of business, the first prize (for total inefficiency) may usually be given blindly to the pay system without much danger of going amiss.

The average system, usually piece work, started by men little versed in modern methods and based upon data usually secured by

the foreman by methods "strictly their own"—and as often totally incorrect—supplies a first-class millstone to burden any concern.

Little faith can usually be placed in the average foreman's estimate of a "fair price" for a job. Lacking proper knowledge himself, he will, however, unhesitatingly and with a great display of confidence, place a price upon any piece of work. Then follows the old story of, first, excessive earnings by workmen; second, dissatisfaction on the part of the employer, and consequent reductions in price; and, third, the invariable result of discontented workmen, who find that their only protection from reductions in price lies in the strict adherence to a certain limited rate of earnings and hence of production. The foremen continue blithely to set the prices, the employer suffers unconsciously through excessive costs and limited output, and the workman works away discontented and determined to even up matters for unfair treatment. These conditions are still very prevalent.

It is astonishing to note the manner in which otherwise sensible men will put into effect and enforce methods and policies vitally affecting the workman's daily life, without regard to the "human element" that enters into his makeup and that the manager should know must of necessity be reckoned with.

Much has been said about the tendency of the modern workman to limit his output and not put forth his best efforts to improve either himself or the company's product. This complaint, however, generally comes from the manufacturer who does not consider it worth while to give close attention to such details as are mentioned briefly here. Seldom is it heard from the manager who wisely "puts himself in the other fellow's place," and then builds up his plans along lines that he realizes would mean encouragement and inspiration to him were he in that other fellow's place.

Any man who has sufficiently clear vision to recognize such faults existing in his business must make up his mind to start right in at the bottom and build up. No points can be neglected. The faults in organization and methods mentioned in this brief outline, if

existing, must be eradicated before any permanent or really effective improvement can result.

II. Defects of Systems and Methods of Manufacturing.

It is not my intention to do more at this point than to point out the most serious defects of the ordinary systems, as the succeeding chapters will deal with the defects and suggested methods of betterment quite fully. The need of system is, of course, becoming more widely recognized each year. But in many cases the manufacturer stops just short of full success. Many times he also fails to realize the full purport of his system and to reap the full, and, in fact, the greatest benefit possible from it.

The Stock System.

To the manufacturer who is not thoroughly awakened to modern possibilities, the stock system is simply a means of keeping track of his stock. It may never occur to him that it is possible to develop it easily so that he can cut down his necessary working capital to a minimum and reduce his interest account to the lowest point possible, or that, by a little development and attention on the part of several intelligent men, monthly inventories correct within 1½ and 2 per cent can be easily secured and made the basis for an exceedingly valuable factory profit-and-loss sheet, so that factory conditions can be accurately noted monthly.

The Order and Tracing System.

The order and tracing system are often considered "necessary evils," and yet the great success of many a concern depends upon the promptness in filling orders and keeping delivery promises, and the tracing system is responsible for this.

The tracing system as an aid in keeping down stock investment

through keeping the regular stock constantly moving is also often a new idea.

The Cost System.

The possibility of ascertaining the cost of the article is often the only thought in the manufacturer's mind when the "cost system" is mentioned, and is accordingly its only function that is developed. In fact, however, the valuable analyses of costs, operation by operation, to be secured from an efficient cost system, supply the manager with invaluable data from which to work in *reducing* costs. Nor does their effectiveness stop here. If it is decided to start a campaign to increase the efficiency of the factory force and to eliminate the inefficient men, then the individual records of the man will be secured from the cost records. In large bodies of workmen, a steady and intelligent campaign along these lines will work wonders.

While to some this last point may appear to be an unnecessary refinement, it must be admitted by all that a cost system must provide a method of cost analysis which will unerringly reveal the points of high and excessive costs throughout every stage of manufacture. The failure to accomplish this means the failure of the chief function of any cost system, namely, *making possible the greatest economy in manufacture.*

Linked up closely with the cost system is the "system of pay" or the wage system already touched upon. This will be handled fully later, but must be mentioned now because of its great importance. It, and the "method of organization," form the two pillars upon which rest the whole framework of a successful concern. Any weakness here is felt throughout the entire structure.

Machining Methods.

Closely linked up with the cost system and wage system are the shop processes of production, such as machining, assembling, etc. The lack of system in the first two almost invariably means a

deplorable lack of proper results in the shop processes of production. The lack of accurate information relative to the amount of work that can and should be turned out from a first-class tool is astounding. In many shops it is only another case where those methods which vitally affect the cost of production are "up to the foremen," and the foremen, lacking knowledge and experience, cheerfully run their departments year in and year out, satisfied if they turn out sufficient volume to keep the "super" off their trail.

In my own shops before they were reorganized I have seen cases where one department was operating the machinery at such cutting speeds and with such depths of cut as to show a loss of 21 per cent when compared with another department directly beside it but under another foreman. And, at that, both departments were far below the standard of efficiency they have now attained, and the end has not yet been reached.

In this matter understand me clearly. The average foreman wants to do well and to make a good showing. But he cannot but lack the desired (and indeed necessary) training and experience to secure proper results. The only proper method of handling these men is to *train them*. It can be done. It has been done with fine results. Necessarily, then, this vital information as to what should be produced from any one machine is usually lacking "in the front office."

I recently installed in certain factories several large boring mills and heavy planers built by two of the highest grades of manufacturers. In order to test the amount of knowledge possessed by the manufacturers of these machines, they were called upon for advice as to the best results that could be secured from them when working under differing conditions. Simple questions were asked as to the speed and depth of cut possible in order to secure the best results. These builders of the tools could not give a definite answer that would be of any material assistance to any one needing light. They knew that their machine tools ran as fast and "would turn out as much work, etc.," as any in the market, but when it came to the

question of shapes of tools, depth of cuts, results upon differing grades of metal, results from the use of water and composition on the tool, etc., they floundered hopelessly. The lack of knowledge of the best results obtainable is not by any means confined to the older type of shops. There is many a factory today which to the eye presents a modern appearance, with its new buildings, well ventilated and cleanly, its fine equipment in machinery and tools, and its show of bustle and hustle, which yet needs the "doctor's care" badly.

The shop, whether new or old in appearance, operating under the older methods of obsolete of obsolescent wage and shop systems, hampered by lack of accurate knowledge of best obtainable results in up-to-date processes of production, by lack of progressiveness and lack of "pulling for the good of the company" spirit in the working organization, is far behind in the race for commercial supremacy.

III. Defects of Sales Department and Executive.

The Sales Department.

Thorough and careful consideration of sales-department methods is considered essential in this discussion. A full study of any business is incomplete if the sales-department methods are neglected. For the "production of orders" is a most essential link to the chain.

The possibilities of scientific development in this branch of the ordinary business are so great that they must be carefully studied. To this statement I often hear the manager say: "Scientific development of the selling end of the business! Why! a salesman is a salesman. The selling of the goods is an art in itself. A matter of individualism. Salesmen are born, not made. Training of salesmen! Bosh!"

The managers who make such statements are usually of the type that will employ a new salesman, let him "dig around the shop a bit," give him a catalogue and start him out. A mere "taking of orders on price alone," not a finished salesman. For the gulf of difference

between a man who takes orders because he quotes lower prices than his competitor, and the salesman who sells the goods at a higher price than his competitor because of his skill and knowledge of his business, is a very wide and deep one. That there is a "psychology of salesmanshp" I would be the last one to deny. But innate selling ability, unless backed up by proper knowledge, will not win. Add to natural selling ability a thorough training in the "talking points" of the product, the defects (and good points) of the competitors, the best methods of meeting arguments and objections, gained from the experience of all the best men in the selling organization, the most successful means of demonstrating the merits of the goods to the prospective customer—and you have a strong salesman.

Train your men collectively, thoroughly organize them along scientific lines, and then back up your training by simple yet adequate systems whereby you may know that the territories are being completely covered, your prospective customers are being handled properly, profitable prices being secured and competition being met, and you will have an invincible selling organization.

Instead of this condition, one often sees a group of salesmen, jealous and distrustful of each other, lacking in the desire to work together for the good of the company, without a thorough knowledge of the company's goods or their competitors' product, and very chary about sharing what knowledge they do possess either with each other or with the poor newcomer. Usually the firm itself is almost entirely responsible for such conditions.

The possibilities that lie in the development of proper methods are astounding. Actual experience to be described in later chapters has proven it beyond the peradventure of a doubt.

The Executive.

The weaknesses outlined in the preceding pages will surely be felt in the executive division whether that consists of one man or twenty. With the possibility of securing only such insufficient

data as can be obtained with lack of organization, methods, and systems, such as has been outlined, what can the executive do but struggle along in the dark and in doubt, trusting that his untrained salesmen can sell his product for such a price that a reasonable profit will be shown after his factory, without proper organization, system, and training, has produced? In passing, let me state again that there is many an executive today who, not realizing the inefficient condition of both branches of the organization, wonders what there is wrong with a business that apparently is in good condition as far as surface conditions are concerned. To such I say analyze the business to the uttermost. Compare it with a modern concern with an organization built upon lines that inspire the workers in it to give their best knowledge and ability to further its progress, with methods that ensure the best results in cost and volume, and systems that will not only tell the story of progress but also indicate the "Sticking Points"—and then begin to build along proper lines. And when the work is once begun, never let up; fight it out to a finish. It will pay.

Chapter II.

THE PRACTICAL WORKING OF THE COMMITTEE SYSTEM.

CONSIDERATION of methods for "curing industrial inefficiency," or for increasing such efficiency as we may already have in the factory, will be much simplified if we keep in mind the classification of defects given in the preceding chapter. If we get the causes of loss clearly recognized and logically grouped for study, we can easily see what must be done (and what *must not be done*) to change these harmful conditions and to secure the much desired improvement.

This classification of the sources of loss and waste in a manufacturing business was:—

1.—Defects of factory organization—of the superintendent, the foremen, the job bosses, and the usual methods of management.

2.—Defects of manufacturing systems and shop methods.

3.—Defects of the sales organization and sales methods, and of executive control over the entire business.

Let us understand fully at the outset that there is no infallible panacea—no ready-made "system" which will fit all cases alike. Methods must be suited to the circumstances of the particular shop or department. The first thought in regard to any plan, indeed, must relate to its adaptability to existing conditions and processes, and to the character and ability of the existing men in the organization. Their sympathetic support *must* be secured, whether the new plans affect methods of organization, systems, or shop processes. The most thorough and effective system in existence will not bring the degree of success that should be attained unless it is supported by superintendent, foremen, and job bosses—and workmen. I hap-

pen to know of five cases, of importance because of the size of the concern and the thousands of dollars that were wasted, where this mistake was made and failure resulted.

The new systems all "cut and dried," were figured out carefully "on paper," new printed forms were prepared, the old forms destroyed, and the start made. The men introducing them, desiring to retain the full credit and glory for the innovation, made the mistake of refusing to call in the different members of the organization and trying to secure their support, but instead attempted *to force* their pet plans through. They met with instant though covert opposition. Unexpected obstacles suddenly blocked the way—obstacles not apparent to the investigator, but which lay hidden away amongst existing shop processes and methods that could not be changed, waiting to spring up and prevent the longed for progress—all of this to the delight of the men in the departments, who chuckled to themselves (and to each other) because of trouble arising from some difficulty with which they were thoroughly acquainted, but concerning which they said nothing "because they weren't asked."

In one case in particular where the system required an especially large expenditure, its introduction was apparently successful though accomplished after many a hard wrench and pull. However, this apparent success lasted only so long as the devisers of the plan were on the ground to see that its vital points were not neglected, its essential features not abandoned. But when they left the shop and their pet system to the tender care of the old organization, there began a process of disintegration, imperceptible but effectual. The tendency of the workers to abandon gradually methods with which they possibly were not altogether familiar, and certainly not in sympathy, was practically irresistible. Little by little they slipped back, giving up one idea after another, until the result was a heterogeneous mass of methods, part belonging to the new system, part to the old, the final condition being worse than the first.

Oftentimes lack of knowledge of details leads a manufacturer to entrust the important work of reorganization to those who can talk the loudest and make the greatest show of a little knowledge. So important is this work, however, that it may well claim the closest attention on the part of the manager himself. The "show me" attitude is nowhere so important. If you don't know or understand, stay with the problem until you do. Don't let anyone else decide these important things for you.

The support, the co-operation, of the men forming your organization is, then, essential. To enlist it, they *must* have some part in forming the plans, some share in devising the systems. They must be made to feel that the methods are their own. They must be consulted frequently and thoroughly concerning the difficulties and encouraged to suggest ways of overcoming them. If some comprehensive plan that will *ensure* this result—such, for example, as the committee system—can be worked out and put into effect, the difficulties will quickly disappear and ways and means for overcoming the "unexpected obstacles" will soon be found.

With these fundamental principles clearly in view—(1) that reorganization plans must be adaptable to the conditions of the business, and (2) that they must enlist the co-operation of the personnel—we may lay down three ruling ideas which must govern the manufacturer in introducing new profit-making methods into his factory:—

1.—All plans must be based primarily upon recognition of the human element of the men who are affected. Always keep in mind this: "How would I act were I in the other fellow's place, with his limitations of knowledge and experience, and what plans would be most likely to elicit my support, develop my latent ability, and bring out the best that is in me for the support of the company?"

2.—The plans must be developed along the lines of the modern "get-together spirit." The facts must be recognized that, nine times out of ten, the joint advice of five men conversant with a sub-

ject is immeasurably superior to any plan developed from one man's brain; that the only possible method of developing a proper shop spirit is through getting the men together; that you can eliminate their distrust and jealousy of each other only by bringing them into close contact one with another, handling them tactfully and showing them they are "not such bad fellows after all," that the spirit of "helping one another for the good of the company" can only be brought forth through the spirit that develops *from* coming together; that the feeling of concerted action on subjects vital to the company's welfare can be cultivated—gradually, perhaps, but easily—if the proper attention is paid to it.

3.—Thoroughly developed methods of overseeing and checking up production conditions, both as to volume and costs, are vital. System provides these for the management. The heads of a concern cannot see everything, but they must come "mighty near knowing everything," or at least be in a position to scent danger, locate it, and eradicate its cause promptly.

Hence the systems for the factory, sales, and executive divisions must be developed with the idea of providing the heads of a concern with accurate methods of overseeing the entire company; systems which will provide an executive, possibly totally ignorant of factory or sales processes, with data sufficient to enable him to lay his finger on the "Sticking Point," whether it be excessive costs, overproduction, delayed shipments, or unprofitable sales.

Formation of the Committee System.

And now we come to the initial step—concrete, definite, and simple—by which the human factor is recognized, the spirit of co-operation is fostered, and the idea of order and system is implanted.

It is evident that there is but one way to secure the advice on vexing problems of those best qualified to counsel, and also to stimulate these men to give the company the best that is in them. That is by forming "Standing Committees," to handle matters pertaining

to routine production and to solve other important problems such as those relating to progress, invention, and economies in production, and promotions.

In each factory the problems relating to the foremen who would naturally form the committees, and to the work, vary so as to make any hard and fast rules out of the question. But in ninety-nine cases out of a hundred the factory superintendent, naturally the final authority in all cases, should be the chairman of the most important committees. In the case of large concerns, where the superintendent would naturally have several assistants, these may be the heads of the less important committees, though in many cases the work of the committees renders the assistant unnecessary. The superintendent himself in all cases, however, should be the head of the Main Factory Committee.

I find that six men form the ideal committee as to size. Any larger number than this is liable to prove unwieldy.

These committees are in all cases of an advisory character.

The General Factory Committee.

There should be first a General Factory Committee, with the superintendent as chairman, formed to care for the most important questions arising in a shop. The members of this committee should be selected with great care, and with a view to having the brighest, most progressive men in the shop upon it. While of course it is advisable to consider the character of departmental work in charge of the different men when making the selection, so as to have experi enced men on the committee, at the same time a serious mistake will be made if this is the only point observed when choosing them. Ordinarily, the personnel may well consist of the chief designer of product, the chief designer of tools or the head of the tool room (preferably the latter), the head of the cost department, and two or possibly three foremen. In the case of assistants, these should form part of the committee. They, however, should *not take the*

place of the foremen, even if it be necessary to increase the number on the committee. Accurate notes of actions taken are of course necessary. A capable stenographer to act as secretary is always a valuable adjunct. Further, an efficient secretary can straighten out many a difficulty between meetings, and the knowledge of shop conditions he absorbs is of great value.

Work of this Committee.—As stated before, no hard and fast rules can be laid down relative to the work of this committee; but, generally speaking, it can well consist of the following:—

1.—Plans to standardize product, and consideration of new methods of design.

2.—Consideration of actual progress made upon new ideas already introduced into the factory. (A most important subject; for the way in which valuable ideas, bravely begun, can be totally buried and lost sight of in the press for the necessary everyday output, is often discouraging.)

3.—Consideration of possible economies and the systematic planning of reduction in cost. The mere starting of a general discussion often opens up a surprisingly large field for this highly important work. Reports by foremen upon economies, decided upon at previous meetings, and assigned to them to put into effect, should invariably be required.

4.—Consideration of routine work, both stock and contract, and of progress upon it. Thorough weekly reports fully covering this subject are of the greatest importance.

5.—Promotions. While naturally the superintendent should be the final authority to act upon promotions, the plan of having this committee pass upon them in an advisory manner proves most salutary. Not only is the management thus assured of the best possible selection of men for important positions, but also the worker far down in the ranks will feel the effect of appointments based upon merit, and free from any taint of unfair influences of relationship or personal friendship.

Meetings.—The number of meetings to be held will depend upon the character of the business—usually two a week will suffice. But one point should be insisted upon: *There should be stated times for these meetings and nothing should be allowed to interfere with them.* The tendency to slight the meetings after the plan has been in effect for a time and has straightened out the kinks is very strong.

Subsidiary Committees.

Most companies manufacture several different lines of product, or a number of important variations upon this product. Each line should have its own committee.

The men forming the Factory Committee should act as chairmen of these different Subsidiary Committees, their selection being determined by the character of their work and their experience. Each committee should be made up of the foremen handling that particular line of product. Very often other members of the Factory Committee, and especially the tool designer or tool-room foreman and cost man, should be called into these meetings, where possibly the same stenographer should act as secretary as in the case of the Factory Committee. At first glance, this may seem an unimportant point; but it is not so, by any means, when you consider how much information of great value to a first-class superintendent a bright man in this position will absorb.

Work of these Committees.—While the work of each of these committees is naturally restricted to the details connected with one branch of production, still the work done by the Factory Committee as applied to that particular line will naturally be handled by it. Important matters for consideration would be:—

1.—Standardization and new designs.

2.—Progress on new ideas already introduced, with reports from the foremen responsible for pushing them.

3.—Consideration of possible economies and reduction in costs. Full reports from foremen upon assignments relating to this work.

4—Routine work, its condition and progress, with reports from foremen responsible, showing whether or not each job, be it stock or special contract, is making proper progress so as to meet delivery dates.

Job Bosses' Meeting.

Naturally, the next step is that the foremen shall hold meetings with the job bosses. Some may think this an unnecessary refinement of the committee system. I regard it as an important link in the chain. Naturally, these men cannot be taken away from their work very often without crippling the output; but short and sharp meetings with them every two weeks are strongly advisable, for necessarily upon these men ultimately falls the responsibility for pulling many a project through successfully. Many a cherished plan of great importance evolved by the head of the company will succeed only through their help; many a one will fail because of their opposition. Never forget, either, that these men are the backbone of the shop in labor troubles. They are the *future foremen*, and the development of the best ones amongst them is of prime importance.

General Foremen's Meeting.

A general "Foremen's Meeting" should be held once a month. In addition to the attendance of the foreman and assistant foremen, the presence of the members of the Factory Committee and of the superintendent should be required. Indeed, the presence of at least one of the higher officials of the company is advisable.

At these meetings the heads of the several committees should touch upon the important problems before their particular committee requiring solution. Many points relating to progress of important work can be profitably discussed. Each man should invariably be required to make a statement as to the condition of his own department, a statement whether or not he or his department is responsible for any delays or trouble in any other departments, and a further

statement as to whether or not any other department is causing him or his department difficulty of any character. With the knowledge that they cannot deceive the well-informed committeemen before them, such a method of procedure soon develops many an interesting situation, and leads to the discovery of many a "Sticking Point." The discussion that naturally ensues soon leads to definite plans for the overcoming of these difficulties.

A most profitable part of this meeting is a discussion of departmental records for the past month. These records can include such subjects as "Economies Effected," "Costs Reduced," "Suggestions for Improvement," "Production Records," "Departmental Expenses," and many others of an intensely practical and beneficial character.

You may be sure that each and every foreman will strive to his uttermost to present a clean slate, a good record, if he knows that such departmental records will be openly discussed before his fellow foremen, the committeemen, the superintendent, and other officers of the company. I recall very forcibly my own animated and determined efforts to present a good record before such an audience, when I was the head of important divisions of work in several large manufacturing concerns. The existence of this spirit amongst the other heads of departments was also very evident. The average foreman can present to any one man his side of any story very skilfully. It is an entirely different matter, however, to tell the same story before a body such as I have described. It must be absolutely correct, or it will be instantly contradicted.

In presenting matters before these bodies, very effective use can be made of folding blackboards. I continually use a type containing ten leaves, each leaf 36 by 28 inches. These fold together like a book. The entire set can be closed, and a lock placed on the cover. Their value is apparent. As our men often say, "nothing gets away from that blamed blackboard." An order from the executive to consider and bring through to success any certain plan is placed upon

the board and certain portions of the work are assigned to different men, these assignments being noted upon the board. *There each stays until it is accomplished.* It has always been of much interest to me to note the effect upon the foremen. The thought that "that blackboard" contains these data, and that in four weeks it will appear staring them in the face, always worries them, and arouses their determination to accomplish the task so as to have it "rubbed off the slate." I receive reports right "from the blackboard" showing progress made or lack of it. The average manager needs no assurance as to the effectiveness of such a plan. It is a wonder worker.

The Workmen.

That this committee system has a good effect upon the workmen cannot be denied. They are undoubtedly affected by it. The position of job boss becomes a more attractive prize to strive for. They soon see, too, that under such a system unfair selections to such a position by the foremen become very rare, inasmuch as a foreman will seldom risk recommending a man to the Factory Committee for promotion on any basis other than that of merit. The danger of being caught is too great; and then again, the rivalry between departments becomes such that the foreman very soon learns that he cannot afford to take such action, because he thereby immediately affects the efficiency of his department. He soon learns that under such methods inefficiency becomes apparent at an astonishingly early date.

I do not intend to deal at this point with a comprehensive plan for increasing the efficiency of the working force, for a thorough consideration of many other practical points, such as wage system, rate of pay, sanitary conditions, etc., is first necessary; but it is necessary to emphasize the fact that some such plan as that outlined is absolutely necessary *as a foundation to work upon*; for you must give the worker "his chance" to advance in fair competition with others in order to develop his latent efficiency.

Again, such a system assures the company that any policy affecting its workmen, which it desires carried out, *will be carried out.* I have often seen the humanitarian, fair-minded policy of the manager of a business so mangled, twisted, and torn out of shape by superintendent, foremen, assistant foremen, and job bosses, that its original owner would never recognize it by the time it reached the men and began to affect their daily life.

Such a system cannot be equalled as, first, a discoverer, and second, a developer, of the strong men in the organization. After all, success in any project is only a question "of the right man," *first, last and all the time.* Consider how enormous is the practical benefit! What a method for pushing improvements, for controlling production so as to meet dates, for reducing costs, and, last but by no means least, for inspiring the foremen, job bosses, and workmen to do their best, through their natural ambition, under a system that provides them with a chance to show their worth! How they will grow and expand under such conditions! The words *esprit de corps,* and "working for the good of the company," are no longer empty phrases, but are illustrative of a spirit of enthusiasm, of good fellowship, and of determination to do their level best, which constitutes the best asset the company has, and the greatest and strongest force that tends toward success.

Chapter III.

REPORTS; THEIR NECESSITY—AND THEIR USES.

"THE secrets of cheap production!" The secrets that every manufacturer ardently desires to discover; that every wide-awake maker of manufactured articles wants to adapt to his own business!

The place of first importance in all the methods and processes that will be considered in this series must be given to the comprehensive Committee System which has been fully treated in the two preceding chapters. While the consideration of ways and means of increasing output, lowering cost, and improving quality leads us through a discussion of the several lines of department activities of a well organized business, the underlying principles of the "Committee System of Management" will be constantly referred to, and the great effectiveness of this system will be constantly employed to help us in solving many an intricate problem of management, method, or processes. Knowing so well its tremendous benefits in the development and management of large industrial enterprises, I consider it the best, and, in fact, the only, foundation upon which to build a thorough plan for reviving a run-down concern, or for developing even a well organized business to its fullest power and possibilities of profit.

The work of the committees as outlined will however be immensely expedited if material for their deliberations is ready in written form —if there is "something before the court" at once upon its assembly. The result of their consultation also should often be permanently recorded. And the data of progress throughout the factory must come in concise expression to the manager's desk. The necessity

for comprehensive reports of varied character is, therefore, obvious. The exact character of these reports and the ground that should be covered therein is not always so obvious. In fact, seldom is there found a system of reports that is really *comprehensive* and *logical.*

Any attempt to define a system of this character must be at first general in character because of the differing conditions in each business. I have, however, applied the fundamental ideas explained below to a number of lines, and have never yet failed to make a practical application of their meritorious features, although their form was greatly changed.

In developing such a line of reports, let us begin by considering what we need in the way of methods to increase the working efficiency of the concern, and what will enable us to oversee and check up thoroughly both production and sales conditions. First, then, we want methods for determining what *must be accomplished* in the production division—in the character, regularity, and volume of output, in the cost of production, in the development of new ideas or inventions to conquer competition, in the steady development of greater efficiency and reduction of costs. Second, we want methods for determining what volume of business must be secured, and what profit must be obtained, on each and every class of goods manufactured, in each selling territory; what expense can be allowed to pile up while the goods are being placed upon the market. Next, we need methods by which the selling organization can be forced to meet these requirements and bring the necessary results.

In short, we must have plans and methods by which the manufacturer can first get a clear conception of what *should* be accomplished in each division of his business; and next, means by which he *can get a firm grasp upon the details* of his business so as *to force the accomplishing* of these longed-for results.

In general outline the reports must be:—the "Monthly Analyzed Profit and Loss Sheet," the "Sales Reports," the "Factory Reports"

and the "Cost Reports." All will be more fully outlined as the discussion develops, but the scope may be outlined as follows:—

The Monthly Analyzed Profit and Loss Sheet.

This report should show:—

a. Delivered sales, with proper divisions for each class of goods produced, and receipts of other character.

b. The factory cost of the goods in each division.

c. The cost of delivery, including freight and cartages properly classified.

d. The receipts and disbursements on all work of a character auxiliary to the main lines of production, such as repair departments, moving departments, etc.

e. The selling expense, divided into proper classifications for analysis.

f. The office and general expenses that can properly be charged against each selling branch or territory.

g. The division of general or executive expense of such nature that it cannot be charged directly against a branch.

The importance of this report will be immediately recognized. It provides an analysis that enables any manager to locate immediately *the points of profit* and *the points of loss, provided* the distribution of credits and debits is correctly made. It is the primary report upon which the balance of the reports are founded. While it may appear complicated, the business man knows that it is necessary; and the one who fears its complication can be assured that it can be developed very easily by ordinary methods of accounting and the inauguration of comparatively simple systems in the factory.

The Sales Reports.

Coupled with the preceding report should be first, a comprehensive memorandum outlining in a simple manner the *necessary work* of the selling department, no matter how the goods are distributed

upon the market. This report should show *what goods* must be sold, *at what profit* they must be sold, and *under what expense* they must be sold, *in order to secure the desired profit on the balance sheet at the end of the year.* It is not a difficult matter for an intelligent man to take such a report as the outlined "Analyzed Profit and Loss" report, consider what profit his business *should show,* and calculate from this *the profit he should expect from each branch of it* in order to secure this profit, and under what expense it is *possible to run* in order that his gross profit from his sales may not be eaten up by selling and general expenses. A simple enough method of procedure, but one seldom taken. And often where this sensible calculation is made, little real scientific effort is made to "hew to the line," to insist upon reasonable profits, to hold down expenses and to conduct the business along the lines which such an analysis shows are absolutely necessary.

The next report on sales needed is naturally the one *showing the actual results,* territory by territory; showing volume and profit secured and expense of getting the business. It is immediately apparent that a weekly (or in some concerns a daily) *comparison* of the actual sales results with the data showing the results that *must be secured* or—as I term it the "*must* data"—will prove invaluable.

There are naturally a number of sales reports of a different character from these two just outlined that should be secured from the selling end of the business, but they are amplifications of the main reports and will be touched upon later under the sales division.

The Factory Reports.

The discussion of factory reports will naturally follow the description of the factory system and so cannot well be elaborated upon here. They should, however, naturally give the first importance to exhibiting progress upon contract, special and stock work, weekly; showing clearly the location of this work in the shop and the steps taken to get it out on time. The manufacturer who is constantly

harassed by tardy deliveries and hampered by the lack of such data, can hardly realize the effective use that can be made of such weekly reports. The knowledge of exact conditions, coupled with the devising of ways and means to overcome threatened delays, and constant pressure upon the factory, bring excellent results.

The Cost Reports.

Their extent will be determined by the character of the business. But, in general, fully analyzed cost figures sent to the chief executives for their scrutiny, comparison, and criticism, bring admirable returns. Let one of the higher officers bring into a committee meeting, or a general foremen's meeting, a set of fully analyzed cost returns upon some particular line of the product, and begin to inquire of the different foremen present why their share of the expense amounts to "so large an amount," and there will usually follow a red-hot discussion that will throw many a valuable side light upon costs of production.

Again, with accurate cost and stock data it is not difficult to secure monthly stock inventories at least approximately correct. Of course, a perpetual book inventory which enters into the general accounting of the company can be devised. I find, however, that not one manufacturer in ten is willing to spend the necessary money for this. However, he would rejoice over a monthly inventory, secured without shutting the shop down, which, coupled with his profit and loss statement and the data contained in his general books, would enable him practically to secure a balance sheet of the company's operation monthly.

The other important reports upon output, departmental expenses and results, production methods, tool-room results, etc., will be treated later—likewise the strictly executive reports. Keep in mind, however, that these reports are so effective because of the committee system. They should wherever possible be made up by the committee handling the different branches of the product. And you may be

sure that your committee, composed of enthusiastic men whose reputations are at stake, are going to see that progress reports, cost reports, output and production reports, represent the very best that they and the shop can accomplish, when they know that these will be closely scrutinized by the heads of the company.

Chapter IV.

THE DESIGNING AND DRAFTING DEPARTMENT.

AFTER the establishment of the committee system and the foundation of a fundamental scheme of reports, the next logical step in reorganization is the consideration of the designing and manufacturing system, methods, and processes—the consideration of the usual defects, and the determination of plans for remedying them and introducing in their stead the most modern means for efficient, cheap, and accurate production.

The Designing and Drafting Department.

The secrets of cheap production lie first in the organization of the designing and drafting department, whether it be *two men* or *one hundred*, by methods that:—

a. Will develop the possibilities in its working force in both general efficiency and accuracy in details;
b. Will ensure invariably a design on a new or a re-design on an old product that will bring out the best possibilities of manufacture, both as to ease and cheapness of manufacturing, and the use of standard and stock parts;
c. Will bring about intelligent and sympathetic co-operation of this department and the shop, upon both design and methods;
d. Will result, through the mutual co-operation of designer, draftsmen, foremen and sales department, in a constant striving for new and better designs, a more thoroughly standardized product, and lines of manufacture better suited to the needs of the market and better fitted to outstrip the competitor.

In inseparable association with the designing and drafting department is the tool room, including the tool-designing department. Here indeed is the "heart of the shop." An ill managed, inefficient tool room invariably means a run-down shop. A well managed, up-to-date tool room, headed by a first-class, tactful mechanic, thoroughly versed in the possibilities of modern methods, modern tools, modern steels and speeds, should always *head the shop in the right direction* and be *the great factor* in keeping it there if its power is recognized and *properly guided and used.* The general designing and drafting department and the tool room may be properly considered the main levers by which to pry up slovenly and bad manufacturing conditions, and the strongest factors in gaining the desired end of cheap and accurate production. The work of these two departments forms the initiative to modern shop success.

The drafting department, however, does (or certainly should) *originate* the fundamental designs and plans and the accompanying details; yet its work is too often responsible for the "shop deviltry" that shortens the days of many a conscientious factory superintendent; it is the department which is seldom properly conducted, even in well developed concerns, and, in most average or run-down concerns, it is a "fright."

The head of this department, one of critical importance, is often a man of limited shop experience, with little knowledge of methods of adapting design to economical methods of manufacture, no appreciation of the value of standardization or concern for the use of stock parts in designs, but plentifully supplied with the baneful "bump of importance"—the spirit of "know it all." His determination to hold fast to his own ideas is equalled only by his ingenious methods of covering up his mistakes, and an intense jealousy of anyone (especially a shop man) who can or does suggest any improvement in design or method.

Requirements for an Efficient Department.—The first and the absolute requirement for an efficient designing and drafting depart-

ment is an efficient man to manage and run it. No half-baked offspring of a school nor "graduate" of your existing department will fill the bill. Both this department and the tool room call for men of a high type. The more capable, the better. Men in these positions, if properly handled, should prove to be worth any reasonable sum. This particular man, in addition to being a capable designer and draftsman, should possess a thorough knowledge of the best types of machine tools and the most modern machine methods. He should also have a good knowledge of foundry practice and pattern making. To this necessary knowledge, add tact and a willingness to listen to the shop foreman and to follow stock records in designing new or redesigning old work, and you would have an ideal combination; one so rare, however, that I do not advise anyone waiting to secure a man with this desirable combination of qualities. You might have to wait too long.

These pages will outline methods by which this necessary consideration of shop processes and shop knowledge of the foremen (invaluable as it is) will be fully developed and the valuable points incorporated in this man's work. Whatever his qualifications along the lines mentioned, however, he should invariably be progressive to the last degree—ambitious to a fault. His mind must be open enough to consider the needs of the market from the standpoint of the sales department and the progress of the competitor. He should be in much closer contact with the sales department than is generally considered necessary or even advisable. Indeed, the spirit between designer and sales manager is more often one of hostility than of co-operation. And yet "common horse sense" should teach us that this connection should be a close one. The day of hostility between the factory and selling organizations is passing.

I have discussed at some length the requirements necessary for the head of this department because his *importance is vital;* and also because in most cases the man usually in this position falls far short of these requirements, and the firm thus fails to realize the possibilities of cheap production.

In many cases I venture to predict that the special conditions of the case are such as to make it impossible to introduce a new man without danger of serious disruption of existing conditions. If such be the case, then introduce methods of organization and management that will check errors, force co-operation between the drafting room and shop, lead to standardization of product, and provide the inspiration for new and better designs through other sources than an inefficient head. Often it is wise to introduce a new head into the department as a "new draftsman," to work "on the table" until he is thoroughly acquainted with conditions and can take hold of the department without danger of disturbance.

The qualifications of the balance of the draftsmen will depend altogether upon special conditions in each case. I cannot pass consideration of them, however, without suggesting methods of training and advancement that will spur them on to do their best.

Bi-weekly meetings will do much good, and when a draftsman is working upon a special design, meetings with the proper committee will benefit him and improve his work greatly. Encourage your draftsmen to absorb all the shop and foundry practice possible, and to mingle with the shop foremen constantly. Impress upon them the necessity of studying existing machinery and stock conditions.

The general requirements for efficient work in this important department, in addition to those relating to the organization itself, just detailed, can be classified as follows:—

1.—Comprehensive and businesslike co-operation should be established between the designing and drafting departments and the shop foremen. The objects are manifold. Great benefit will be derived from a free exchange of ideas and a free criticism of design by men qualified by shop experience and a knowledge of former mistakes. Assurance will be obtained that every design represents, in its last analysis, the combined knowledge, skill and experience of your best men, and the consequent assurance that when it is produced it will be properly proportioned for strength, will operate

properly, and will *be so designed as to be produced in the cheapest manner possible.* Such conferences will also facilitate the proper routing of new work through the shop with reference to the existing conditions of stock output and machinery.

This co-operation, further, will ensure a most thorough consideration of *re-design of regular product*—a question which is of paramount importance in considering the steps necessary in revivng a run-down concern. The general conditions surrounding the old line of production and the problem facing one in considering the general re-designing of this old line are often well-nigh appalling. But *here you must start and here you must stay* until a general line of procedure is mapped out and progress begun. And, *watch that progress. See that it is made.* Singularly enough (in view of its importance), there is usually a slackening of endeavor, a lessening of effort in the proper direction, after a full plan of this nature is mapped out and work begun. Every excuse of "overload of routine work," "unexpected demands upon time due to unusual conditions," etc., is offered to explain why the necessary progress upon work of a critical nature is not diligently pursued.

Progress every day, if only one new line upon the desired drawing, should be insisted upon, and no excuse for failure to accomplish this little should be accepted. One of the most irritating experiences of the conscientious factory manager is that lack of progress upon improvements that he knows are vital to the business. "*Some progress every day*" should be unflinchingly called for from those delegated to handle these questions.

2.—Standardization is the second great line of advance to be pursued in the designing department. The entire designing and drafting force, from the head of the department down, should always keep in mind the great benefits to be derived from it. While this applies particularly to lines of product manufactured under special contracts and specifications, at the same time much of its advantage can be applied even to the production of a so-called standard article.

In many cases standardization of a product is possible if the sales department can be forced into line and a conscientious attempt made to introduce a standard article on a market apparently requiring goods of special sizes and quality.

The great advantage of this from every standpoint is of course apparent. It means cheapening production through duplication of parts and ease of handling; increase of output per square foot of floor area through quicker production, and the consequent reduction in indirect expense, per piece; the possibility of building for stock in slack times and so keeping up the factory output; quicker deliveries and more orders, better satisfied customers, and a more rapid turning over of working capital—this latter being something that the financial managers of the business will thoroughly appreciate and hail with joy.

The use of stock parts is a profitable step toward standardization even where product in its entirety may not be reduced to standard. The entire drafting force should be provided with books containing full data upon the shop's standard small tools, such as reamers, dies, taps, etc. They should also be continually forced to consider methods of designing so as to use standard and stock parts already manufactured.

3.—Designing so as to ensure cheap machining and assembling is a third prime requirement of drafting-room economy. The men should be continually impressed with the necessity of designing the parts so as to be easily and cheaply machined and assembled, and that, too, upon the types of machine tools already in the shop. The needs of the pattern maker and the possibilities of the foundry should *never* be forgotten. Nor should the tool room and its possibilities in the way of making inexpensive tools be overlooked.

4.—The making and following of drawings should be insisted upon. The designing and drafting department *should make all drawings* of every character. Under no circumstances should any drawings be made by the shop foremen. The up-to-date shop man-

ager will smile at the idea of this being done in this generation; yet I know of several large shops, and many small ones, where this rule is not being enforced, and the shop foremen (in some cases even the job bosses) make many of the detail drawings. In all cases, however, the drawings should be O. K.'d by the shop foremen, either in committee or individually, before they are placed in the shop. The great importance of this is at once apparent. Then, after the drawings are O. K.'d and sent into the shop, *they should be followed.* No deviations should be permitted. If any change is found necessary, then this change should be approved by responsible parties, and made on the drawing.

Reports from the Machine and Assembling Rooms.—Much good can be secured from a simple yet thorough system of reports by the foremen, based upon their actual experience in carrying through their departments a newly designed product, these reports to contain criticisms and suggestions upon design, and ease and cheapness of machining of parts.

In my opinion, all these very desirable results mentioned in detail here can be secured only through the consultation and co-operation of a group of those men best qualified by experience to control and solve the important and intricate problems arising in the consideration of new design or re-design of an old product. I therefore strongly advise the submission of all these ideas to a committee formed of the head designer or draftsman, the head of the tool room, and the general factory committee made up of the factory manager, the important machine-room foremen, and the head cost man. This committee should be supplemented from time to time by the presence of the foundryman, the pattern maker, and the stock man. With such a committee handling the questions outlined, the success of the plan is assured.

In cases where the company is fortunate in having an efficient head designer, such a committee will prove a great spur, and of tremendous assistance to him and to the company. Where no

efficient head exists, this committee will assume the important *rôle* of "originator of new ideas." Let the head of the company place in the hands of such a committee the general problem of the market requirements regarding a new product, or the necessity of re-designing an old product, from the standpoint of trade requirements as affecting either design or costs of production.

The interest shown by such a group is immediate and intense. The result of their thought and work is invariably so far superior to the work of any one man as to admit of no comparison. Supported by such a system, the work coming from the department will be scientifically designed, correct, with every part mechanically strong, and capable of being produced in the cheapest manner possible. The entire design will represent the best ideas of your best men, and every man through his participation in the particular product will be so interested as to do his level best to make a success of it.

The experienced shop manager has only to consider the usual maddening program of errors in data, mistakes of design, faulty judgment regarding economy of manufacture, lack of standardization of parts, and last, but by no means least, the covert hostility of the shop man to the new productions of "that blamed drafting department," to realize the possibilities which lie in developing methods which will ensure accuracy, economy, standardization, and the interest of the machine foremen in the successful and economical production of any particular design.

Chapter V.

THE TOOL ROOM—THE HEART OF THE SHOP.

IN the preceding chapter I advanced the proposition that the essential preliminary step in the reviving of a run-down concern is the thorough reorganization of the designing, drafting, and tool rooms, along rather new lines. The necessary conditions to be secured in the first two departments were fully dealt with and the functions which the tool room should exercise toward the manufacturing processes at large were outlined.

In order, however, that the tool room, by its organization and equipment, may be enabled to lead the shop toward the goal of manufacturing success, it must itself be instituted for the highest efficiency and economy in the production of tools. I feel that too much emphasis can not be put upon the conception that this is the place to begin the work of reform, by close examination of the existing conditions and rectification of existing defects. It remains, then, to show how the maximum possibilities of the tool room may be realized. My suggestions are the result of experience in a number of very trying cases of factory inefficiency, and the remarkable results coming from the adoption of the plans described fully justifies strenuous insistence upon the statement that this is the real starting point for the campaign of physical improvement.

The Tool Room.

The tool room, as already mentioned, has been aptly called "the heart of the shop." It is the most important department in any shop, if its full functions are developed aright. If the designing and drafting department is weak, the wide-awake shop manager can

supply the defects through other sources, if necessary; but if the tool room is in an inefficient condition, the whole shop will invariably be in correspondingly bad shape. A well organized and well equipped tool room, even though it be a very small one, in charge of a progressive, wide-awake, thoroughly experienced man who is willing to co-operate with the balance of the shop, is essential in the reviving of a run-down concern or the improvement of one not "up to the proper mark of efficiency." It is always interesting, when inspecting a shop that is in bad shape, to visit the tool room and note how closely the entire shop conditions conform to the tool-room conditions. At times a good machine-room foreman will build up an efficient department despite a badly managed tool room; but this is rarely the case, owing to the severe handicap of poor maintenance of machine tools, defective design of cutting tools, and the impossibility of securing any accurate, first-class milling fixtures, drill jigs, form cutters, etc., designed to produce the machine work more economically.

It is not my intention to treat here the questions of tool-room equipment and methods of operating a tool-supply room; for these questions have been fully discussed frequently, especially in a series of articles that have appeared in The Engineering Magazine.* The needs of different shops differ, although the equipment of lathes, milling machines, universal milling machines, grinding machines and one or more planers is common to all tool rooms.

A number of systems for tool supply-rooms have been described, so that little need be said on this subject, except to insist upon having some accurate method of caring for small tools, keeping them in good condition, and checking up the workmen relative to those tools in their possession. Some simple system of checking up the men when returning old or broken tools should assuredly be kept. The item of broken tools can become a very large one if the workmen

* See especially the articles by John Ashford, July and August, 1904, and by R. Emerson, Dec., 1904 and Feb., 1905. Ed.

learn that little or no attention is paid to their record in this matter. A simple report showing breakages and the parties responsible for them will enable the shop manager to locate his careless workmen.

My main object at this time, however, is to bring out clearly the tool room and its functions as factors in the development of a shop toward a high standard of efficiency, particularly when its initial state of efficiency is low; to show how this department can prove its value in making possible the determination of proper standards of production rates, the devising of vital data for a proper wage system, the introduction of economies which the cost system shows are possible, and the lowering of production costs through efficient maintenance of machine tools and the building of new tools especially designed for the particular product manufactured.

The determination of proper standards of production rates is a subject which will be treated fully in a later chapter. Its great importance is obvious. The possible output of the shop, the lowest possible cost of production, the determination of wage-system standards (in itself a subject of great importance), all depend upon the accurate determination of the lowest possible time in which each piece of work can be completed. The method of keeping the individual workman and the shop keyed up to that rate is an entirely different subject, to be discussed later. But the *initial determination* of this possible speed of production is vital. The necessary tests are by no means simple matters. They involve accurate knowledge of the best results possible from the high-speed cutting tool steel, the proper shape and size of cutting tool, a knowledge of the character of the steel worked upon, and of the greatest capacity of the machine tool used, without too great an expense for maintenance and depreciation.

Tool-Room Methods.

The conditions surrounding tool-room work often make it difficult to apply the same methods towards the hastening and cheapen-

ing of production therein which might be applied to the production departments. Day pay is the usual rule. Owing to the character of the work, any other wage system is generally impracticable, and even if practicable would be inadvisable because of the necessity for accuracy.

Nevertheless, even granting the difficulties that beset one in trying to apply the principles of cheap production to this chief agent of progress and economy, the tool room itself—still, so high is the expense per man when compared with that prevailing in the balance of the shop, so costly may the tool-room product run, of so great importance is *rapid* production, and last, but by no means least, so many are the opportunities for "laying down on the job" without the possibility of detection of any such costly tendencies—that some comprehensive plans *must* be adopted, first, to ensure the cheapest possible methods of production, and, second, to check up foremen and workmen properly as regards costs and accuracy. If these points are properly covered, the *rate* of production will care for itself. Such a policy is especially necessary in the care of the run-down concern with an inefficient or "slow-gaited" tool-room force, whether the tool-room force is a large or small one. For, to state an important point which I shall want to emphasize, we must always keep in mind not only the possibility of wasted money through excessive tool costs, but also, and indeed *especially*, the waste of valuable time in securing tools by the use of which large sums can be saved in the shop.

We must, of course, assume that the tool room is supplied with a full equipment of high-grade machine tools.

First get a first-class, high-grade tool-room foreman. This cannot be emphasized too strongly. Do not plan a campaign of improvement with any expectation of a satisfactory outcome unless this first step is taken. Well paid, high-grade mechanics are, in the end, the cheapest labor for the tool room. The mistakes of the low-wage workman are too costly. Owing to the high hourly rate of the

tool maker, thorough organization in the tool room is necessary in the interest of low costs and rapid production of the tools themselves; but beyond this, is the great importance of getting the new tools into service. Delays are doubly costly, as already pointed out; and yet unless the tool room is well organized and systematized, it is often more productive of "unaccountable delays and disappointed hopes" than of the new and much needed tools. The dilatory movement of the ordinary tool room constitutes one of the most trying experiences of the factory manager.

In the older types of shop, even where large forces of tool makers are employed, the practice of allowing the expert high-priced workman to machine up and fit all the component parts of a single tool and then assemble it into the finished product still prevails. Under such conditions, this high-priced tool maker will be found machining up jig bushings, legs, special screws, and other parts of special tools that can be easily standardized, and in many cases will be turning out in small quantities work that should be handled on stock orders and turned out in large quantities by much cheaper labor at a fraction of the cost.

The similarity between this method of building tools and the old-time methods of building the finished machine for the market is striking. But just as the old-time method of construction in the case of the finished article was found too slow and costly for modern conditions of trade and competition, and has been rapidly supplanted by comprehensive plans for standardization, duplication, production in quantities and careful supervision of labor, just so the old-time tool-room methods are being changed so as to take advantage of these obviously economical steps in the building of costly tools.

Standardization.—A tool-room force working under the old-time methods just described will produce in the course of a year sets of tools that are distinguished chiefly by a great lack of uniformity and absence of any attempt at standardization. Yet a close study of the ordinary shop tool conditions and requirements will prove that the

standardization of many parts is possible if only a thorough-going attempt is made to effect it. This applies particularly to those shops where the tools are of the smaller sizes. For example, in the case of drill jigs, such parts as bushings, legs, stops, screws, pins—and even the bar stock—can be standardized to a comparatively few sizes.

Duplication.—Once this is done the duplication of these parts in quantities and the keeping of them in the stock bins for immediate use becomes possible. The savings are at once apparent. First, a large reduction in the initial cost results because of this production in quantities, and that too by a much lower priced workman than the tool maker. Again, the possibility of always having these parts on hand when wanted by this tool maker will invariably result in a large saving in both first cost and time.

Subdivision of Labor.—The modern practice tends therefore toward the same rigid subdivision of labor in the tool room that exists in the production department. The high-priced tool maker does no work that can be performed by cheaper men. Not only are those parts that can be standardized and machined in quantities produced by a less expensive class of labor, but also much of the closer work in milling, turning, grinding, etc., is often handled by special men who do no other classes of work. Thus the tool maker, instead of laboriously producing each and every part of any tool at great cost and loss of valuable time, becomes an expert adjuster and assembler, receiving promptly from various sources many portions of the tool he is to finish, these parts requiring simply the finishing operations at his skilled hands to bring them "to size."

In one large shop under my management, where conditions were unfavorable, we applied these rules of subdivision of labor and standardization to great advantage, especially in the building of large numbers of small drill jigs. The screws were standardized. All stops, legs and other small parts were turned out in large quantities on the automatics. The bushings, also manufactured in large quantities, were turned into stock in such condition as to require

simply the finishing operations by the experienced tool maker. Even the bar steel forming the top, bottom, and sides of the jigs, was finished to standard dimensions, cut off to standard lengths, and placed in stock for immediate use. The tool-designing department followed closely this scheme of standardization, the result being a large saving in tool costs, even though at times slightly more metal was used in the jig than was required by either the part to be manufactured or the character of the operation. This extra cost was saved many times over in the lower wage cost, due to the fact that the high-priced man had only a few finishing operations upon the component parts of the tool, and thus became an assembler and adjuster to a large extent.

In addition to this pleasing reduction in cost, there ensued a still more satisfactory increase in the output of greatly needed tools from a department handicapped by lack of room and of high-grade tool makers.

The Small Shop.

In the case of the small tool room of very few men such subdivision of work is often impracticable. But even in a department composed of four or five men, common horse-sense methods applied strictly to their work will result in a saving in both money and time that is of great importance and fully proportionate to the savings in the large departments. In shops where the tool-room force is a small one there usually exists a tendency to ignore this part of the organization and let it get along as best it can. This is a vital mistake. In the first place, the tool-room force is seldom half large enough considering the great value of its work. Again, the relative importance of this department in the case of the small plant is fully as great as in the case of the large company. Its work bears the same relation to cost, accuracy, and quickness of production in one case as in the other. Whether the department be small or large, the same methods of organization, division of labor, and checking up of tool costs can be used to great advantage.

Speeding up Tool Production and Checking the Cost.

Lost time in the tool room, as already pointed out and emphasized is a more serious matter than in any other department in the shop, since delay in the production of a tool means not only a high rate of increase in actual cost of that tool, but may often involve a continuation of a shop loss which could be avoided were the tool in use—a loss often many times the cost of the tool itself.

The importance of adopting up-to-date methods for increasing tool-room production and for checking up and lowering costs then seems obvious. And yet the lack of effort to accomplish these results in most well run modern shops (to say nothing of the poorly managed) is as singular as it is prevalent. The belief seems to prevail that the cost of a tool is too difficult a matter either to estimate or investigate. And yet the admission of the fact that it is a difficult question to solve makes the possibilities of loss in many directions the more apparent, the need for some method of removing them the more pressing.

The peculiar conditions make the problem a hard one. The work is usually altogether special and must be done upon the day-work basis of pay. The difficulty of securing proper economical results from this day-work system often leads to lax methods in administration and management. The amount of time wasted by workmen under the day-rate system, unless they are rigidly supervised, is astonishing. Only an approximation to a "few days work" is often secured with difficulty. Even rigid supervision avails but little unless it is supplemented by some system that will prove a spur to the men—some system through the use of which the good men may feel that there is an opportunity for recognition and reward, and laggards may know equally well that if they do fail to produce work in a reasonable length of time they will surely be noted for punishment.

Tool Cost Card.

The tool-room system advocated here depends upon the determination (by estimate) of the proper tool-room costs, item by item, operation by operation, *before work* begins upon the tool; and then, after the tool is completed, the *comparison of the actual with the estimated costs*, and especially the noting of the records of the rapid and the slow workmen as shown upon the cards.

The card on the following page is self-explanatory.

Form of Card.—The form given is merely suggestive. In some cases, the division of "operations" is unnecessary. In other cases, they are important. In most cases, the total time in which the work is actually done can be placed upon the card after the operation is completed; inasmuch as the man has before his eyes a statement of what *should* be done, he will know what he is accomplishing in the way of speed of production and he is certain that his record, be it good or bad, will "go up to the front office." Immediate and insistent inquiries as to causes and reasons for delay, when these occur, should invariably be made. Substantial benefits may be derived by offering to the men fair bonuses in case they secure a clean record of work done within the estimated time in the course of the week. This offering of bonuses removes the idea of "driving" which is so distasteful to many workmen.

Such a system, simple to the last degree, still is remarkably effective. Indeed, it is so effective because it contains, in simple form, the fundamental principles underlying all progressive methods of increasing shop efficiency, namely:—

1.—Determination of time in which work *should* be done.

2.—Placing it before the workmen themselves in definite form.

3.—Holding before them the chance for rewards in bonuses and promotion for record work, and the fear of reprimand or discharge in case of failure through carelessness, negligence, or laziness.

TOOL RECORD CARD

Tool No._____ Drawing Nos._____

_____

_____

Name of Part _____

Name of Part of Tool	Operations	Estimated Costs	Actual Costs	Name of Workman	Remarks

Total Costs Labor_____

" " Material _____

Complete Cost_____

This Tool must be completed by_____

Date of Completion_____

If any delay, Why?

Special Instructions

Design and Estimated Cost Approved by

Tool passed by Committee_____

Sig. of Sec'y _____

SUGGESTED FORM FOR TOOL COST AND RECORD CARD.

The Tool-Room Committee.

The question that immediately arises will be "Who sets the estimated time for the work and who checks up the actual time required?" I answer "The committee, as described in the preceding chapters of this book."

While the work of this committee will be varied, its functions many, still they will always relate to the one main object so ardently sought for—cheaper production costs.

Its members are vitally interested in the original cost of the tools and the rapidity with which they can be gotten through the tool room. These members are usually better qualified to estimate the length of time that should be required to build a tool of any description than any one man or group of men. After a short experience in estimating and checking up costs, they will soon become sufficiently expert to answer the purpose.

Method of Procedure.—After due consideration has been given to the tool model and the design of the tool itself, the estimate of cost of the tool should be determined and the record placed upon cards as noted. These cards should always be issued from and by this committee, so as to have the proper effect upon the workman. The card should travel with the work so that the workman may have a constant reminder beside him as to the time in which this body of men expect the work to be completed—a constant reminder that any failure to live up to the estimate will be surely noted upon this card and an explanation required—that his failure makes an indelible record against him which will infallibly be seen by those in charge of the shop and commented upon to his disadvantage—that a poor excuse for his failure will only blacken his record still further—that, on the other hand, any betterment of the estimated record will be noted with satisfaction by these same men and will surely redound to his credit. A first-class honest workman will be pleased at the opportunity afforded him of placing an evidence of his superior ability upon records which are lasting and which are noted by those high in authority with a

view to future promotions. The loafer and sluggard will soon be detected and can be sought out for improvement or discharge.

Owing to the fundamental importance of the work of this committee and the fact that upon it hangs most of the burden of bringing the shop to a condition of high efficiency, a short *résumé* of its functions, mentioned briefly in Chapter IV, may well be brought out at this point.

An outline of its province would be somewhat as follows:—

1.—Planning new designs of product to meet new market conditions in such a manner as to ensure:—

a. Proper construction and accuracy of operation.

b. A course of manufacture that will result in the lowest possible cost of production.

2.—Planning the re-design of an old product in the interest of economy of production.

3.—Devising and considering plans whereby the shop production efficiency may be raised to a high point.

This involves:—

a. A close consideration of cost data so that the problem can be attacked at its most critical point.

b. The devising of full sets of special tools so as to make possible the attainment of the desired end of lower manufacturing cost.

c. The thorough consideration of these tools from the standpoint of design and *low production cost.*

d. Investigation of existing manufacturing conditions in the shop, and the careful planning of methods through which a high state of manufacturing efficiency may be reached. This itself involves a thorough knowledge of the types of machine tools best adapted to the work, and the best results that can be obtained from them through the use of modern high-speed steel for the cutting tools—a big subject in itself concerning which there is still a lack of definite data.

e. The determination of "standard time" (or the time in which each job of work should be done) on each job in the shop by calculation and test. This work is of an importance that can aptly be termed critical. It is perhaps the most important work of the committee. As I will explain in detail later, I do not consider that the committee itself should attend to the tests and the determination of the standard times, but the head of the tool room should actively direct the work under the strict supervision of this committee. The work, especially at its inception, should be constantly considered by this body in order to ensure proper results.

Tool-Room Committee Membership.—In ninety-nine cases out of a hundred, the head of the tool room, supplemented by one or two of the best machine-room foremen and the head cost man, form the best group for undertaking this highly important work. Full reports of comprehensive tests made to determine the best production possible from each machine must be made the basis for one line of shop rejuvenation. The investigation of machine-shop processes and methods can best be made by such a group. The result of such action will invariably be as surprising as it is profitable.

The designing of new tools holds great possibilities for economy or waste. Of course, the simple designing and building of new tools in a haphazard manner can be left to the head of the tool department and his tool designer; but only "haphazard results" can be expected. The results attained from this general method will often prove futile, for the head of the department is seldom in a position to determine by himself the most important problems to attack. I have seen the results of many weeks' work in the tool room thrown away almost immediately after the completion of a new set of tools, because of some change in method and design that upon examination proved profitable.

The work of laying out a thorough, consistent, and profitable line of work for the tool room requires judgment of the highest quality. If the original designing or re-designing of the product deserve the attention of the best qualified men in the organization, formed into a committee, then certainly this even more important and vital work should receive like consideration. In fact, consideration of the design of a new or old product, and consideration of the tools necessary to build the component parts of this same product, go hand in hand.

I therefore urge the serious consideration of the tool problems by the committee formed of the head of the tool room, the head designer, the members of the factory committee, the head of the cost department, and any other of the machine-room foremen in whose departments the work is to be performed.

Keep in mind that the most important—the really vital—"secrets of cheap production," can be solved only by the work of these two departments, and particularly of the tool room.

If your shop is not producing as much as it should, or the costs of production are too high, then *start a campaign of rejuvenation.* But start it through the designing department and the tool room, whether these departments number hundreds of men or but five. Map out a logical and systematic plan of improvement, working through these departments, calling to your aid also the active heads of those departments who meet and conquer the difficulties of manufacture daily, and whose suggestions and aid will prove of peculiar value.

You can thus be assured of a product designed along lines that are practical, accurate, and that meet the requirements for economical manufacture. Coupled with this, you will secure from the work of the tool room and its committee data relative to possibilities of speed of production that are vital, plans for new systems of manufacture that are often radical, and as profitable as they are radical, and plans for new systems of tools that will often revolutionize individual processes and bring about great reductions in cost.

Chapter VI.

MINIMIZING THE TIME OF MACHINE-TOOL OPERATIONS.

TWO fundamental principles of cheap production lie hidden away amongst inefficient shop processes, bewildering disorder of shop conditions, and lax, inaccurate, and utterly misleading shop methods. They are of the greatest importance, and yet nine times out of ten a searching investigation will prove that little consideration has been given them in ordinary shop practice. They are so closely related that their simultaneous discussion is advisable. They are both essentially "time savers." These two principles are:

1.—The determination of "standard time" for each job and its tabulation, introduction, and enforcement.

2.—The absolute elimination from the workman's routine of every duty but that of running his machine continuously and efficiently; the bringing to him of tools and stock for his next job before he is ready for it.

The first and possibly the more vital of the two is the determination of standard time upon each job—that is, the shortest space of time in which each job should be completed (including setting up), under normal conditions and with due regard to the fullest possibilities and capacity of the machine tool, the cutting tool, and the stock.

An appalling undertaking, this, in most shops, under existing conditions; appalling and seemingly impossible because of lack of knowledge of the best shapes for cutting tools, of the best methods of hardening and grinding, of the results to be secured from the use of high-speed steel cutting tools, of the best methods that can and should be adopted by a skilled workman, of the capacity of the

machine tools in the shop, and, worst of all, because of the lack of men skilled in the best methods for handling these cutting tools—men capable of doing the work and of seeing that the workmen do it.

It scarcely seems necessary to argue in favor of this determination of standard time; and yet many manufacturers seem to prefer to leave the question of the rapidity of production to the foreman's judgment and skill alone. Their confidence, while perhaps amiable, is usually misplaced. No man with real shop experience will assert that the average foreman does, or in fact can, know the best results that can be secured in machining today, unless he has been afforded and *has accepted* exceptional opportunities for making thorough tests of a really scientific character—something that rarely happens. Even should a foreman possess this desirable knowledge, it is beyond the power of any one man to supervise properly any group of men, even though small, so that the high point of efficiency may be assuredly reached, and at the same time do the other work that usually falls to the foreman's lot.

Again, the use of high-speed steel for cutting tools is a development of recent years. Notwithstanding all that has been published on this subject, comparatively few shop foremen really know what the fullest possibilities of its use are, and fewer still ever force their departments to use it to its fullest efficiency even after its value has been recognized. In fact, there have been comparatively few tables ever published that show in a practical manner just what can be done with it. The machine-tool builders themselves, singularly enough, seem to be unable to give any positive, accurate advice as to the actual conditions of cutting speeds, feeds, and depth of cut under which their own tools can best operate, and even the makers of the tool steels do not provide tables of much practical use.

Nevertheless the work of such a man as F. W. Taylor, in his remarkably thorough and extremely valuable publication, "The Art of Cutting Metals," clearly shows the possibilities that lie in the use of these modern cutting tools—Messrs. Taylor and White being the

discoverers of these possibilities and Mr. Taylor himself leading the van in the application to practical use of these principles. This one work makes clear not only the great possibilities but also the great difficulties that originally lay in the path of the investigator. With all of these points in mind, it is simply "rot" to give heed for a moment to any claim of any shop man that his knowledge of this subject is at all exhaustive.

Standard times should be determined by *some one, some how.* Certainly no one can dispute the fact. Experiments and experience show that the good old plan, "depending on the foreman" for this determination, as mentioned above, gives results 40 to 60 per cent short of maximum efficiency. Inasmuch as your entire business is built upon and depends upon the cost of production—or, in its last analysis, simply "the time it takes each man to do his job of work," it is of *fundamental importance* that that standard time be first determined by methods that will ensure accuracy.

The second cardinal principle of cheap production stated at the outset was "the absolute elimination from the workman's routine of every duty but that of running his machine continuously and efficiently; the bringing to him of tools and stock for his next job *before he is ready for it.*"

The machine hand, assembler, or other worker must be forced to concentrate his skill and attention upon his own work and that work alone, making it impossible for him to waste his time (and thus the employer's money) upon work he should not do. Consider for a moment the many things that a machine hand, for example, will ordinarily do other than operate his particular tool, and then give a moment's thought to analyzing the result. The worst "time wasters" can be classified somewhat as follows:

a. Running to the supply room for stock for a new job. Result, the machine tool is shut down.

b. Getting tools, clamps, etc., from the tool room for a new job. Result, the machine tool is shut down.

c. Grinding his own tools (and very badly at that). Result, the machine is shut down.

d. Excessive time in "setting up" a job, due to lack of proper instruction, or to a tendency to "soldier" because of lack of supervision. Result, the machine is shut down.

e. To these add the further tremendous loss of output because the workman fails to use the proper—the very best—cutting speeds, feeds, and depth of cuts, through either lack of knowledge or lack of supervision, and you have a combination that cuts the output of the ordinary shop far below what it should be.

If your shop is running under ordinary foremanship supervision, with no thorough method for bringing to the workman his stock; for providing him with tools for the next job before he is ready for it; with no method of instructing him what to do and how to do it, and no thorough way of comparing his output with what it should be according to the best standards of today, (mark me! not your foreman's standards)—then you can make up your mind that your output is far too low according to the best standards of production.

You may imagine that "carefully calculated" piece-work rates will protect you; but if your piece-work rates have to allow for the conditions stated just above, you are deceiving yourself grossly as to the possibilities of your output.

The important consideration is time! time! *Time of the workman running his tool*—that is the vital point. Every minute counts for profit if this tool is operating continuously and efficiently; for loss if it operates under the nullifying influences detailed above.

Consider for a moment! Your entire factory investment—building, power plant, transmission plant, all probably built and selected with great care and expenditure of money—is simply to care for and operate the separate units of machine tools, or to house properly your assembling spaces. Your investment in machine tools represents large sums. This vast expenditure is made with but one object

in view—that of producing work and producing it as cheaply as possible. Calculate accurately your indirect charges of every character; proportion the total against each machine tool according to the "machine-rate" method of apportionment, and note carefully how large must be the rate per hour for each machine. This will be found to be an astonishingly large proportion of the labor rate per hour and will prove a good index of the great cost of lost time in the shop.

Is it not clear, then, that each machine tool should be, nay *must* be, brought to *as high a factor of operating efficiency* as possible? Is not your entire investment made with that one end in view? Does it pay to have the efficiency of any collection of these units reduced 15 per cent to 25 per cent by the existence of such shop methods as those detailed, by which the men operating the machines are actually compelled to shut them down to hunt up their next job, to collect their tools, to grind their tools, and to do many things that should be done for them? Can you afford to suffer an even heavier reduction in efficiency due to lack of knowledge of the "best time for each job?"

The importance of these points can be further emphasized by considering that all such delays, which in their total represent a large amount, directly affect cost and profits, output, indirect expense of every description, quick movement of stock, and hence ultimately the amount of working capital needed in the business, and the possibilities of quicker deliveries, with a resultant direct effect upon the sales department and customers. Indeed, aside from the question of costs and profits, nothing is more important to the separate members of a company—from the executives with their financial problems, through the sales department with their selling problems, to the harassed factory manager—than the quick movement of stock.

The reason for the continual absorption of working capital into machinery or stock that worries many a financial officer, or for deliveries so delayed as to affect seriously the efficiency of the selling organization, or for excessive and unreasonable and possibly unexpected costs that seem and, in fact, are out of reason—the reason for

all lies hidden away back in the shop processes and methods. It crops out at the individual lathe, planer, shaper or assembling bench, and then only to the keen experienced eye. The workmen busy? Surely. Look at them hustling! But—see that group around the tool-supply window waiting for tools? How many are waiting at the tool grinders to grind their own tools each in his own "individual" manner? There is a mechanic who has taken twenty minutes to "set up" his job instead of ten. Then pause and wonder how in the world any one or two or more foremen can be sure that the men now operating the machines are using proper speeds and feeds and getting the most out of the machine and the tool.

In fact, the causes for all these serious troubles are located so far back toward the fundamentals of production—the individual units affording the causes are so seemingly unimportant, and such is the difficulty of recognizing these conditions, buried as they are in a busy shop—that they are overlooked or ignored.

As a general proposition, the greater the difficulty of solving such problems the more important and necessary becomes that solution, simply for the reason that in this you are dealing with humane elements to whom is given the opportunity of slowing up in production solely because of that very difficulty that lies within the problem itself and its solution. And yet so fundamental and vital is their importance that they cannot be ignored.

The Starting Point for Minimizing Operation Costs.

Investigation of Existing Machinery.—Any plan for the introduction of proper methods for the determination of standard time and the elimination of wasted time must begin by an investigation of the existing shop machinery—an individual report upon each machine tool, especially touching upon the defects, and a recommendation as to what types should be purchased in the future to meet modern production requirements. This is a matter of great importance, but machinery, designed to stand up under the latest high-production

requirements, are recognized and listed up at the beginning of the introduction of any new plans, this important matter is liable to be lost sight of later, with the consequence that when the time for purchases of new machinery does come, the older inefficient types are clung to and the shop is further encumbered with old-style tools.

Nor is the question of securing a more rigid and efficient tool such a simple question as at first appears. Few machine-tool manufacturers are making an earnest attempt to place upon the market tools strong enough to meet the more severe requirements of today. Why? First, because comparatively few have made tests of sufficient scientific worth to determine where the points of greatest weakness really are and how to strengthen them properly. Second—there is the money tied up in old patterns, old stock in the factory bins, in machines going through the process of manufacturing, and finally in finished machine tools carried in the sales rooms. Changes of a radical character would prove a serious matter under such conditions. And, again, the demand of the manufacturer for better and heavier tools has not been urgent enough to force the machine-tool builder into the tremendous trouble that a thorough redesigning of the older types would surely cause. Therefore the latest product of a machine-tool manufacturer is not necessarily adapted to the methods of production that I am advocating.

Greater driving power is usually the first requirement. Accurate tests have shown that modern lathes, for instance, should have fully double the driving power usually contemplated in their design. This is a point that must be considered carefully. Of course a proper increase in driving power of a lathe, for example, means wider cones, heavier bearings, and stronger heads. Immediately there follows the question of the rigidity of the bed. It is at once apparent that this is a very important point, and yet too little attention has been paid to the design of bed best suited for withstanding the strains and stresses due to the use of new high-speed cutting tools. Solidity is very necessary. The consideration of the need of strength and rigidity should

certainly be applied to the tail stock. Slide rests and tool holders should be simple and strong. The tool must be held rigidly under all conditions. The tool posts should be set down lower than is customary in everyday practice. Under modern conditions much greater feeding power is needed.

But however certain we may be that defects in machine tools have a direct effect upon the rate of production and the cost of the product, existing conditions may prevent purchase of new tools. Inasmuch as I have been through the mill several times with run-down concerns, I appreciate fully the fact that most manufacturers are obliged, through sheer financial stress, to ignore any scheme, no matter how promising, that involves at the outset a thorough replacement of the existing machinery with the most modern types, even though it can be demonstrated that the latter are 50 per cent more efficient.

The practical question that confronts many a manager is: "What on earth can I accomplish with my *present old* 'rattle traps' of machine tools? I couldn't buy gold dollars for 98 cents if I had to pay cash, much less spend thousands for replacing my present machinery. *I must first make good with what I have.* After we are on firm ground we'll talk about stronger and better machine tools."

True! Very true! A viewpoint very often overlooked by the manager, or by the man who has this work in charge but doesn't have to produce the dollars to "keep the old ship afloat." This latter situation, which is a stern actuality with many a man who is eager to improve conditions, is all compelling and must give shape to the preliminary methods of procedure. This I shall try to keep in mind.

Granting, however, the hard fact that many concerns are obliged first to dig out the problem, using their existing facilities, it is of all the greater importance that two reports relative to machine tools be made out:—

First, a report showing what heavier, stiffer, and more efficient types of machines should be substituted for existing types when the proper time comes.

Second, a full report upon each and every machine tool in the shop, showing its points of weakness and its limitations in cutting speeds, feeds, and depth of cuts; how it can be strengthened; a description of the kind of work that should be done on it; a record of best times on jobs; a full statement of the best machine tool to substitute for it, and a clear-cut comparison of possible production by the use of the latter machines.

I warn you again that unless this be done systematically at *the start*, it probably never will be done; then as time goes on you will find yourself burdened with many a newly purchased machine tool just as weak and inefficient as the older one it replaces.

In considering the problems of increasing production in any particular shop, we find therefore that they become problems of devising methods and making tests upon the supposition that existing machines and facilities must be used in regular production—that, however advantageous the latter types of tools, the important question of lowering costs must be considered on the basis of developing to the uttermost the efficiency of the present machinery. We must therefore keep in mind these points in the building up of our system. The great importance of gathering all our data systematically and of using them scientifically cannot be too strongly insisted upon.

Chapter VII.

POSSIBILITIES ATTENDING THE USE OF HIGH-SPEED STEEL.

CLOSELY linked with the study of the design, character, and remodelling of the existing machine tools, is the second great step in the betterment of machine processes—the use of high-speed steel cutting tools.

The possibilities underlying their introduction and full employment have been thoroughly discussed by other writers and proven again and again in everyday shop practice where thorough methods have been adopted. It is sufficient to say that the increase in production over that secured through the use of the older carbon steels may be expected to reach from 40 per cent to 85 per cent (depending upon the character of the metal being cut) if the machine tools are in proper condition to withstand the strains of the increased cutting speeds, feeds, and cuts. If the shop under consideration is in a run-down condition, and there has been lack of system in shop processes as well as lack of efficiency in production methods, a much greater increase than 90 per cent may reasonably be expected. I have noted myself records of over 200 per cent increase in efficiency and output, and have been shown records in a number of cases that exceed 300 per cent. Of course to anticipate such large increases in all cases would be foolish, but there are many cases today where such results are well within the range of possibility. Such a prize is well worth fighting for.

Before passing to the important questions that follow I cannot forbear pressing upon the interesting fact that in a great number of shops the recognition of, and the tremendous enthusiasm for, possibili-

ties of high-speed steel for cutting tools and for better production processes, seem to be confined to the primary installation and the first fever of enthusiasm over its introduction; after this, the shop often settles down to a dead level of production far below its proper point, and the ultimate increase in efficiency, instead of being fully 60 per cent or more, is nearer 12 per cent.

How often have I seen a shop, in its first spasm of delight over the discovery of high-speed steel and its possibilities of increase in production as applied to their peculiar circumstances, eagerly scanning new records, planning great things for the future. Often the officials are brought into the shop to see the first results. Mayhap the president will take into his office some of the pieces for paper weights, look them over gleefully, compare the new and the old records with the fine showing of increased efficiency, and take pleasure in the thought of what he will do to the trade when all his work is produced at such a low cost. And then this matter of getting the best results from the new methods is placed in the hands of a few ignorant foremen—each with different ideas as to the forging, dressing, hardening, and grinding of these tools, with no definite idea as to proper shapes, angles, and clearances, and no real knowledge of the possibilities of production that rest in the proper treatment of the problem. Soon the entire important question is swallowed up in the pressing problems of everyday production, and the only real knowledge that the manager possesses on the subject is that "We are buying and using regularly brands of such-and-such a make of high-speed steel."

Later on the official will pick up his "paper weight" and wonder what has become of the expected reduction in labor cost that at first appeared so simple to make. Somehow or other his cost records do not show those material reductions that he assumed were assured. The cause? Lack of method.

This is no fairy story nor dream. If the manager of the average concern wants to ascertain the fact that these comments in all proba-

bility apply to his own shops, let him, *after ascertaining what should be accomplished* upon, say, certain classes of lathe work, then go down into the shop and ascertain for himself just what *is being done.* And while on the way to the shop itself, don't stop at the factory office and ask any foolish questions, for if you do, "information galore" will be your lot, but as for actual facts right from the machine tool—little of it for your portion! But let us turn to measures by which the use of high-speed steel may be made to yield the maximum results in regular work:—

The Provision of Abundant Cutting Tools.

The determination of proper and standard shapes for cutting tools, and the supply of a sufficient quantity to avoid lost time is the first point of attack. Before another step is taken these standard tool shapes *must be determined* and *must be rigidly adhered to.* The old tool dresser, who is in all probability totally ignorant of the proper shapes of tools as determined by scientific experiments, and probably stubbornly sticking to his "home-made" knowledge of hardening the modern tool steels, must be eliminated. The practice of allowing a hundred workmen to grind their tools in a hundred different ways must positively be stopped.

In place of these haphazard, inefficient methods must be substituted those that will lead to the adoption of standards proven by experiments and experience to be efficient, and these must be adhered to without deviation.

In view of the differing opinions of factory men upon the subject of proper shape of tools, it is fortunate that we can refer to the results of and deductions from the experiments of Dr. Nicholson, and later, and indeed especially, to those of Mr. F. W. Taylor of Philadelphia, as guides which can safely be followed. The latter tests of Mr. Taylor are especially exhaustive and convincing. The results of the tests performed in a modest way under my direction are confirmed by Mr. Taylor's data. The limits of this article prevent any lengthy dis-

cussion of the many important points to be observed; they must be skeletonized only.

1.—In determining the most effective shape for any tool, such as for instance a lathe tool, careful consideration must be given to the fact that limitations may have to be placed upon the shape which would provide the greatest cutting efficiency, by the necessity of considering the difficulty and cost of forging and grinding. These costs may prove such as to require a modification of the type which *per se* would be the most efficient.

2.—The dynamometer tests by Dr. Nicholson demonstrated the fact that a tool with lip angle of 54 degrees (cutting angle 60 degrees, clearance 6 degrees) would remove soft steel at a low degree of pressure. Such an acute angle, however, can hardly be considered for commercial use, because of the danger of crumbling. He established the fact, however, that we should generally adopt the sharpest angle of cutting tool that would not crumble under the strain of working conditions. His tests showed that on medium cast iron cutting angles should be 76 to 80 degrees (with clearance of 6 degrees) and consequently their lip angle should be about 70 to 74 degrees. His tests upon soft steel were not conclusive because of work conditions, but the tests he made indicate that a cutting angle of about 70 degrees (lip angle 64 to 65 degrees) lasted the longest time in rapid cutting.

Mr. F. W. Taylor's tests show that tools for cutting softer steels should have a clearance angle of 6 degrees, back slope of 8 degrees, side slope of 22 degrees, or a lip angle of 61 degrees. For cutting cast iron and harder steel the tool should have clearance angle of 6 degrees, back slope of 8 degrees, side slope 14 degrees, or a lip angle of 68 degrees. On harder steel a clearance angle of 6 degrees, back slope of 5 degrees, side slope 9 degrees, or a lip angle of 74 degrees is recommended. On chilled iron a lip angle of 86 to 90 degrees is recommended.

Great care must be exercised to see that the point of the tool is

blunt to such a degree that crumbling cannot occur. The round-nose tool with a large radius of curvature has been adopted by me as the best of its type, although straight broad-nosed tools can at times be used to good effect. As regards the question of side slope *vs.* back slope I favor steep side slope, though guarding to the utmost possible against gouging into the work. A combination of these two can be secured that will produce good results.

This question of shapes of tools must be thoroughly thrashed out and settled by the expert and the committee before another step is taken. Decide upon your standard types. But whatever types are decided upon, by all means adopt a few set rules in regard to tools, and stick to them.

First. Reduce your sizes of tools and the types of tool steel to a minimum.

Second. Adopt standard shapes and then don't change them.

Third. Stock up your tool-supply room with plenty of small tools. Keep the workmen supplied.

Forging.—The final standard shapes of tools having been decided upon, then take up the important question of the proper forging of the tools. Here is where vigilance should begin. In the first place, limit gauges will pay. Your tools must be forged to the correct shape and in such a manner as to reduce the preliminary grinding to a minimum. The shapes must be considered with care so as to provide for cheap and effective tool grinding after the tool begins its life of usefulness. Naturally the conclusions reached in the consideration of standard shapes will influence very largely the methods of forging. Do not run the risk of starting cracks in your tool steel by nicking it and breaking the pieces off cold. In heating the tool do it slowly so that the heat will have ample time to penetrate the entire bar. Unless this is done cracks may develop. Bring it up to a light yellow.

Hardening.—Considering the large volume of good information now available as to the best methods of hardening high-speed tool

steel, it is strange how often we find the toolsmiths adhering to plans of their own.

It is of great importance that your toolsmiths should be given to understand that any adherence to the old "color" ideas in the processes of hardening must be absolutely abandoned, and that the newer methods of hardening recommended by the makers of tool steel must be absolutely followed. At one time the methods described by the makers were unnecessarily complicated, in order to throw a certain degree of mystery around the processes, but of late the tendency has been toward a decided simplification.

It is highly desirable that the number of grades of high-speed steel used in a shop be reduced to as low a number as possible—certainly not over two, and, if possible, one—and that a thorough standard method of hardening be adopted, and adhered to. Owing to the tendency of the ordinary toolsmith to slip back into his old slipshod ways, it is important that some accurate record of his hardening processes and some check be kept upon him, especially during the period when practical methods of hardening are being introduced and thoroughly standardized. The record need be only a simple one, but must be sufficient to enable you to trace unerringly any defects appearing in the tools due to bad process of hardening, and to center the responsibility for these mistakes upon the toolsmith responsible for them.

I therefore suggest the form on the opposite page for keeping hardening and tempering records.

The methods of hardening lathe, planer and boring tools are fully described by the makers. Generally the forged nose of the tool is placed in a well-burned-through coke or coal fire, and brought slowly to a white welding heat. This heat should be raised to a point where the nose begins to soften. Care should be taken to see that this heat extends over fully three-quarters of an inch of the nose. At this fusing heat, the white-hot part should be put immediately under the strongest and coldest air blast which is available, compressed air being

HARDENING RECORDS.

Date_____

Tools	Size	Quality of Steel	Lot No.	Remarks

Hardening Heat Temperature.
Cooling Agents.
Tempering Heat Temperature.
Toolsmith._____
If defective, Why?_____

FORM FOR HARDENING RECORDS.

the best to use. Under no circumstances must the tool be brought in contact with water while it is hot. It is probably preferable to harden the white-hot nose of the tool in fish or lard oil until it grows moderately cool, and then to continue the cooling-off under a cold blast.

Mr. Taylor, in his description of the heat treatments, brings out the important feature that the nose of the tool should be heated *slowly* to a bright cherry red, so that the heat may penetrate to the center of the tool. From the bright cherry red up to the melting point, the tool should be heated as rapidly as possible in an intensely hot fire until the nose of the tool begins to soften. He urges very strongly the importance of using an intensely hot fire for the second period of heating.

The cooling of the tool should be done rapidly until it is below 1,550 degrees F. From this point it makes little difference whether

it is cooled rapidly or slowly. Mr. Taylor advises the use of a bath of red-hot molten lead in bringing the tool down below a temperature of 1,550 degrees.

In his article on the "Art of Cutting Metals" he brings out the advantage of the second or low-heat treatment, which is obtained by re-heating the tool which has had the high-heat treatment to a temperature between 700 and 1,240 degrees F. Great care, however, must be used to see that the higher temperature is not exceeded, for should this happen the quality of the tool will be seriously affected.

For the heating of special form tools, milling cutters, etc., special methods are of course necessary, the use of the ordinary coke or coal fire being out of the question. Where a number of these parts are heated at a time, great care must be taken to see that they do not touch one another. Special furnaces should be used. These can now be purchased for a reasonable figure. In these furnaces the work can be properly suspended so that separate pieces will not come in contact with one another, and accurate control of the heating can be secured with the aid of a pyrometer.

Grinding.—As was pointed out under the heading of shapes of tools and forging, it is necessary to determine these shapes with care so that the cost of grinding the tools will not be excessive.

It seems hardly necessary to assert the importance of having all tools ground in one place and according to standard shapes There are, however, a surprising number of shops still left in which the workmen are allowed to grind their own tools in their own way. Inasmuch as tests show that the shape to which a tool is ground will affect its efficiency to a very high degree, it is perfectly obvious that such a plan as allowing the workmen to grind their own tools is simply ruinous, to say nothing of the question of wasted time on the part of the workmen.

We must, of course, assume that under the heading of shape of tools the manufacturer has determined just what grinding angles should be adopted throughout. It is of much importance that these

angles be rigidly adhered to, not only because they will prove the most efficient, but also because all the tabulations which any one may make up for any particular shop will be based upon these standard shapes and consequently any variation from these shapes will tend to vitiate the records and so annul the good points of the determination of standard time.

In my opinion, all grinding of tools should be done by automatic machines, so that all angles can be ground uniformly. If, however, this grinding is still to be done by hand, it is very important that you get a thoroughly skilled man and watch him with extreme care, especially at first, to see that he will adhere to your specifications for grinding angles. If you do not watch him, he is almost certain to slip back to methods of his own or to adopt those of other men in the shop. If this grinding is done by hand, then provide the tool grinder with proper templates and tables so that the possibility of mistakes will be eliminated as far as possible. Such is the importance of grinding these tools accurately, however, that an automatic machine grinder will be found almost necessary.

Overheating of the cutting tool during grinding is one of the greatest causes of deterioration of quality. Caution is generally impressed upon the people handling these tools, and it can not be urged upon them too strongly. Many a tool apparently in good condition has been ruined by overheating in the grinding operation. The tool should be moved continually. A cooling agent directly on the nose of the tool should always be used. Many makers of high-speed steel state that while grinding on a dry wheel may be done, at the same time *great care must be taken* to see that the tool *is not discolored, i. e., overheated.*

I concur in the statement of Mr. Taylor that on the average a lathe tool should be so operated that grinding would be required at the end of an hour and a half, going, of course, upon the presumption that the tool is of standard, high-grade quality. In many of the tests on which records have been presented and in the data which are

always submitted by the high-speed steel maufacturers, we find a continual reference to the length of time a tool runs without regrinding. This, however, is of very little interest to the average manufacturer, as the question is not how long a tool may run without regrinding, but how much should a tool be forced so as to produce the most work with a minimum expense for grinding, keeping in mind at all times that the crowding of the machine tool is the important consideration. The question of how long a tool may run without regrinding sinks into the background, especially if the grinding of a tool may be done in a scientific manner by automatic grinders.

The use of cooling agents, such as soda water, is highly desirable. An increase in production of 35 per cent on medium and soft steel can be secured through the use of a properly directed heavy stream of water.

Finally, let me urge the necessity of keeping a large supply of tools already ground up in the tool-supply room, so that, under no circumstances, will the workman be compelled to wait for his cutting tools. This is an important point and is often overlooked.

Chapter VIII.

THE DETERMINATION OF STANDARD TIMES FOR MACHINING OPERATIONS.

ASSUMING that we have determined upon standard shapes and have the proper facilities and men for the forging, hardening and grinding of tools properly, we now come to the consideration of the question of making such experiments as will make it possible to determine with a high degree of accuracy just what the shop ought to be able to accomplish in the way of production with the existing equipment.

To sum up anew the elements of the problem before us, the "standard times" for any shop depend upon the following:

1.—The character and limitations of the existing machine tools.

2.—The introduction and use of high-speed steel for cutting tools. This will include:—

   a. The determination of the proper shapes for tools.
   b. The provision for proper treatment of steel of this character in forging, hardening and grinding.
   c. The determination of the best working conditions possible, such as the cooling agent, etc.

3.—The securing of the maximum possibilities in cutting speeds. This includes:—

   a. The careful consideration of tests already made and submitted by different investigators, giving of course due thought to the conditions existing at the time of the test.
   b. The adaptation of these records to existing shop conditions and the making of thorough tests in the local shop under the limitations imposed by types of machine tools existing in the shop.

4.—The collation of all production data upon a systematic plan and their arrangement so that they can be used.

a. The instruction of the foreman and the workman as to the results to be expected and how to secure them.

b. The insurance that the every-day production follows closely this standard of efficiency.

The first and second sections were discussed in the preceding chapter. The third and fourth—that is, the fixing and the practical introduction of standard times—remain to be considered.

The first problem that confronts the factory manager is how to start to make tests on the bewildering number of pieces used in the manufacture of his particular product. The warning should be issued that unless the work of testing is done systematically much of it will be done without avail and great loss of time will follow.

Classification of Parts.

I have usually found it possible, and strongly advisable, to divide into groups or classifications the parts which are to be manufactured according to these new methods. The first separation which would occur to any one would be that according to the quality of metal used. The second grouping will depend altogether upon the article that is being manufactured. Generally it will be found perfectly practicable to make a second series of classifications depending upon the similarity of design, shape, and mechanical operations necessary. Of course where parts are of the same genus but of different sizes, this is a comparatively simple proposition; but it will generally be found upon analysis that even a further classification can be made under which these groups can be still reduced by considering, as stated above, design and similarity of operation.

I have in mind one shop which required in the course of building, assembling, and making the machines the production of some 9,000 parts. However, by a thorough system of analysis and classification, it was found possible to group these 9,000 parts into less than 250

classifications. It was thus possible to get a clear idea of what should be accomplished on these 9,000 pieces through the results of the 250 tests made in a thorough manner. While it was probably true that the deductions made from these tests were not in all cases as thorough as would have resulted from individual tests, at the same time this plan simplified a tremendous problem and enabled the concern to get a much quicker start on the right road than if a haphazard method of testing these 9,000 pieces had prevailed.

In studying the question of production in regard to any tool, we must consider not only the efficiency of the machine tool and the cutting tool, but also the time that it takes to set up the job on the machine tool in the first place. It is quite probable that a critical examination of the way of setting up the work usually practised will prove that the method used is capable of alterations which will result in a surprising saving of time. A thoroughly scientific method of setting up the job usually results in a saving of 30 to 50 per cent in the time required by the average workman. It is therefore necessary to study this question at the start, as the test is being made, and prepare a list of instructions giving the different operations required in detail and the length of time that should be taken under ordinary conditions to accomplish this job of setting up. This determination of setting-up time should not be left for future tests, but should be done right at the beginning, for if it is not done then, the chances are it never will be done. It is easier to do it at the time of the test than at any other time.

Again, we must consider the time required to handle the parts, especially if they be small so that they can be clamped in and taken out of the machine tool in the shortest possible space of time. A thorough study of this one problem should be made at this particular period. The importance of this is much greater than is usually apparent, especially on parts of small dimensions.

A short time ago, I noted with particular care a workman operating a lathe on a large number of small pieces in a shop where the

PRACTICAL TABLE OF CUTTING SPEEDS IN LATHE WORK, ON CAST IRON, IN FEET PER MINUTE.

TOOLS TO BE REGROUND EVERY 90 MINUTES.

Depth of Cut.	Feed, Inches.	1-Inch Tool			¾-Inch Tool.			½-Inch Tool.		
		Soft.	Medium.	Hard.	Soft.	Medium.	Hard.	Soft.	Medium.	Hard.
3/32	1/64	226	113	66.0	222	111	65.0	206	103	60.0
	1/32	177	88.4	51.6	169	84.3	49.2	147	73.3	42.8
	1/16	130	64.8	37.8	120	59.8	34.9	97.5	48.8	28.5
	3/32	107	53.5	31.2	97.0	48.5	28.3	76.0	38.0	22.2
	1/8	92.8	46.4	27.1	83.4	41.7	24.4	64.1	32.1	18.7
	3/16	75.7	37.8	22.1	66.4	33.2	19.4	....	....	....
1/8	1/64	205	102	59.8	203	102	59.3	194	97.0	56.7
	1/32	160	85.1	46.8	156	78.2	45.6	138	69.3	40.4
	1/16	118	58.8	34.3	110	55.0	32.0	93.1	46.5	27.2
	3/32	97.0	48.5	28.3	88.8	44.4	25.9	72.1	36.1	21.3
	1/8	84.2	42.1	24.6	76.2	38.1	22.3	41.8	20.9	12.2
	3/16	68.6	34.3	20.0	60.9	30.4	17.8	....	....	....
3/16	1/64	181	90.6	52.9	181	90.6	52.9	182	91.0	53.0
	1/32	142	70.8	41.3	137	68.5	40.0	128	64.0	37.7
	1/16	104	51.9	30.3	97.7	48.9	28.5	86.1	43.1	25.1
	3/32	85.8	42.9	25.0	78.0	39.0	22.8	67.4	33.7	19.6
	1/8	74.3	37.2	21.7	67.5	33.7	19.7	....	....	....
	3/16	60.6	30.3	17.7	54.2	27.1	15.8	....	....	....
1/4	1/64	165	82.3	48.1	167	83.6	48.8	173	86.3	50.4
	1/32	129	64.4	37.5	126	45.4	26.3	81.9	41.0	23.9
	1/16	94.3	47.1	27.5	90.8	63.2	36.9	122	61.0	35.7
	3/32	77.8	38.9	22.7	72.7	36.3	21.2	....	....	....
	1/8	67.5	33.7	19.7	62.7	31.3	18.3	....	....	....
	3/16	55.0	27.5	16.1	....	....	....	....	....	....
3/8	1/64	143	71.5	41.8	150	75.0	43.8	....	....	....
	1/32	112	56.0	32.6	113	56.7	33.1	....	....	....
	1/16	81.9	41.0	23.9	81.0	40.5	23.6	....	....	....
	3/32	67.6	33.8	19.7	65.5	32.7	19.1	....	....	....
	1/8	58.6	29.3	17.1	.....	....	....	....	....	....
	3/16	57.5	28.7	16.8	.....	....	....	....	....	....
1/2	1/64	132	66.2	38.6	.....	....	....	....	....	....
	1/32	104	51.6	30.2	.....	....	....	....	....	....
	1/16	75.8	37.9	22.1	.....	....	....	....	....	....
	3/32	62.6	31.3	18.3	.....	....	....	....	....	....
	1/8	54.2	27.1	15.8	.....	....	....	....	....	....
	3/16	44.2	22.1	12.9	.....	....	....	....	....	....

manufacture of small parts prevailed. The machine tool itself was well speeded up and the production was quite rapid. It was an actual fact, however, that the time consumed by the workman in taking out his finished piece and fastening in the machine tool the piece to be worked upon, exceeded by quite an appreciable percentage the actual length of time required for the machine operation of cutting.

While this may to the inexperienced man seem to be insignificant, at the same time the determination of these points is of the greatest value, especially under such conditions as outlined above, because of the fact, as stated before, that "time is what we pay for." Everything possible should be done to cut down that element of time all through the shop processes.

Before starting any tests, care should be taken to see that there is provided a cut meter for measuring the cutting speeds, that the belts are all in good condition, and that the proportion of pulley speeds is carefully checked up. The depth of cut should be very carefully measured, and, as stated before, care should be taken to see that you have tools of uniform character and plenty of them. Even at risk of reiteration, I want to emphasize the importance of this provision being made in advance.

Whatever the condition of your shop and whatever the system of management, it is altogether probable that an expert tester will be absolutely necessary. This man should be one who is totally removed from the influence of the foremen or any of the workmen. He should when possible be placed in some part of the factory where he can work practically unobserved and certainly undisturbed. Wherever his tests are made—specially or in the shop—his reports should be carefully checked up and should be invariably sent to the head office, he being given to understand that he is responsible to the officers alone. The importance of having an expert of this character lies not only in the necessity of securing accurate tests upon which you can depend, but also upon the absolute necessity of training up some man who can properly analyze the possibilities of production, fill out the

PRACTICAL TABLE OF CUTTING SPEEDS IN LATHE WORK, ON STEEL, IN FEET PER MINUTE.
TOOLS TO BE REGROUND EVERY 90 MINUTES.

Depth of Cut in Inches.	Feed. in Inches.	1-Inch Tool.			¾-Inch Tool.			½-Inch Tool.		
		Soft.	Medium.	Hard.	Soft.	Medium.	Hard.	Soft.	Medium.	Hard.
3/32	1/64	490	245	111	482	241	110	445	223	101
	1/32	339	169	77.0	323	161	73.4	281	141	63.9
	1/16	235	117	53.4	217	108	49.3	177	88.7	40.2
	3/32	189	94.5	43.0	172	85.8	39.0	135	67.4	30.7
1/8	1/64	427	214	97	423	212	96.1	404	202	91.8
	1/32	296	148	67.2	284	142	64.5	255	128	57.9
	1/16	205	102	46.6	190	95.2	43.2	161	81	36.6
	3/32	165	83.0	37.5	151	75.3	34.2	....	....	....
	1/8	142	71.0	32.3	128	63.8	29.0	....	....	....
3/16	1/64	358	179	81.3	358	179	81.4	359	179	81.6
	1/32	247	124	56.1	240	120	54.5	226	113	51.4
	1/16	171	85.5	38.8	161	80.5	36.6	....	....	....
	3/32	138	69.0	31.3	127	63.7	28.7	....	....	....
	1/8	118	59.0	26.8	...	....	....	....	....	....
	3/16	95.0	47.5	21.6	...	....	....	....	....	....
1/4	1/64	315	157	71.6	320	160	72.7	330	165	25.0
	1/32	218	109	49.5	215	107	48.8	....	....	....
	1/16	150	75	34.1	144	72	32.7	....	....	....
	3/32	121	60.5	27.5	....	....	....	....	....	....
	1/8	104	52	23.6	....	....	....	....	....	....
3/8	1/64	263	132	59.8	276	138	62.7	....	....	....
	1/32	182	91.0	41.4	185	92.4	42.0	....	....	....
	1/16	126	62.8	28.5	....	....	....	....	....	....
	3/32	101	50.6	23.0	....	....	....	....	....	....
1/2	1/64	232	116	52.7	....	....	....	....	....	....
	1/32	161	80.5	36.6	....	....	....	....	....	....
	1/16	111	55.7	25.3	....	....	....	....	....	....

proper instructions, and be in a position to see, as speed boss, that the men are thoroughly informed as to the methods to be adopted in proving the results which his tests show possible. It is absolutely necessary that you be in a position to demonstrate to your workmen that work *can be done* in the time set for it, by actual demonstration. No one can do this better than this expert tester, and no one would be in a better position to show the workmen how to accomplish the result himself. A man in this position should not only have a high degree of ability as a mechanic, but should also possess a goodly amount of tact.

TABLE OF PLANER SPEEDS ON BESSEMER PLATES.

Planer Number.	Speed in Feet. Cut.	Return.	Feed on Different Thicknesses of Plates in Inches. 1	$\frac{3}{4}$	$\frac{1}{2}$	$\frac{3}{8}$
1—(82)	19	77	.06	.09	.12	.18
2—(767)	30	97	.03	.045	.06	.09
3—(793)	30	88	.03	.045	.06	.09
4—(96)	22	45	.05	.075	.1	.15
5—(107)	22	45	.05	.075	.1	.15
6—(98)	28	52	.036	.055	.062	.11

Tool to be ground at the end of one hour and thirty minutes on the Bessemer plates.

The tables presented on pages 86 to 90 show the best results, to my knowledge, to be obtained on first-class machine tools, such as lathes,*

* The data on lathe work represent the result of experiments made by Mr. F. W. Taylor and his associates and were presented before the American Society of Mechanical Engineers in his paper on the Art of Cutting Metals. The data are presented with Mr. Taylor's consent and are the most comprehensive and valuable of any so far presented to the manufacturing public, to my knowledge. The data confirm throughout in a very striking manner the experiments performed in factories under my direction. They are, however, more complete than the tests made under my supervision.

Our tests on lathes, planers, punches and dies were made with both the Novo high-speed steel of Herman Boker, N. Y., and the Bohler new rapid steel of Houghton and Richards, Cleveland, Ohio, from both of which we have secured most excellent and uniform results. The drilling data were compiled from a series of tests made in our own shops with drills manufactured by the George H. Rich Manufactur-

TABLE OF SPEEDS AND FEEDS ON DRILLS.*

Size, Inches.	Speed.	Feed.
$\frac{1}{2}$	430	.018
$\frac{5}{8}$	330	.019
$\frac{3}{4}$	280	.019
$\frac{7}{8}$	255	.019
1	250	.020
$1\frac{1}{8}$	245	.020
$1\frac{1}{4}$	240	.020
$1\frac{3}{8}$	230	.020
$1\frac{1}{2}$	210	.020
$1\frac{5}{8}$	200	.020
$1\frac{3}{4}$	195	.020
$1\frac{7}{8}$	190	.020
2	180	.020

planers, shapers, drilling machines. Without some such standard guide, the proposition of making a series of standard-time tests in the ordinary factory is indeed a very difficult one. The results shown in the tables may not in all points prove to be the limit as far as production is concerned; but they represent the best so far obtained, and are far in excess of those usually secured, so that they can be safely used as a basis upon which to work and they make the determination of the best time in which a job should be done a comparatively simple matter, as concerns the machine work alone. Inasmuch, however, as they were obtained under first-class conditions, the state of the existing machinery in the average shop will render a modification of these rules and tables quite necessary. It is for this reason that the investigation of existing machinery (referred to in Chapter VI) must be undertaken first, and the tabulations so modified as to apply to the existing circumstances.

ing Co., Buchanan, Mich. The tests on planing and drilling tools were made under the direct supervision of the factory manager of the Herring-Hall-Marvin Safe Co., Mr. E. E. Watson.

*Tests made in shops of Herring Hall-Marvin-Safe Company upon which cast iron, using drills manufactured by Rich Manufacturing Company, Buchanan, Mich.

By the use of tables on lathe work similar to those prepared by Mr. Taylor, I have been enabled in several cases to make large reductions in the force of machine hands. In one instance several years ago, the introduction of a speed boss skilled in the use of these data resulted in cutting down a machine force of 63 men to 22 men within a period of 3½ weeks. In another case, a reduction of over 50 per cent in a large machining department was secured within 5 weeks of the time these tables had been placed in the hands of an efficient foreman and measures taken to see that stock was furnished to his machines promptly. In another case a simple system of using the tables made it possible to reduce the number of planers from 19 to 13. Even with this reduction, the remaining 13 planers gave a much larger output than had formerly been secured from 19.

A systematic use of the tables on the drilling machines produced even more surprising results. In several cases within my own experience a reduction in prices of over 50 per cent was made possible, and in one particular case a reduction of even 75 per cent.

Of course the possibilities of saving in any one shop would depend upon the production conditions existing at the time the tests and examinations were made, but it is safe to say that large economies will result if such tables can be put in effective use in a manufacturing shop.

I have brought out previously the importance of classifying all of the manufactured parts so that attention can be concentrated upon those which are truly representative of each separate classification. And in determining the best place of attack in the classification it is well to remember that, in the average shop, there is usually at least one point which, through bad equipment or ineffective direction, is practically retarding shop progress throughout. With ordinary foremanship it is almost impossible to discover the existence of such conditions. The Tool-Room Committee and the tester, who is destined to become later the speed boss, should therefore first determine the classifications and the best point of attack. After time calculations have

been made and approved by the Committee, with the aid of the tables just given, they should be placed on record cards (which will be considered later) to be confirmed by the tester in actual trials.

It is important, however, to note that in the manufacture of either single large pieces or many small parts, there are a number of elements entering into the cost of production, other than that of machining, which are always of sufficient importance to merit the closest consideration. In fact, very often it is the lack of attention to these other factors that accounts for much lost time. This is particularly the case where large quantities of small parts are manufactured, each part in itself requiring but a slight machining operation.

Almost without exception the tables which have been so far presented represent machining of rather large bodies, while in many cases in actual manufacture the problem is one of the turning out of product of small dimensions. The question of "handling time" in this case becomes of paramount importance. This brings us at once to a consideration of the following requirements, all of which must be considered by the committee, whether the pieces or the quantity be large or small:

1.—There must be ample stock delivered to the workman before he stops work upon his preceding job. This is an item of practice which will in itself bring surprisingly large returns in efficient production. In fact, if nothing more were accomplished than the constant supplying of the workman with plenty of stock, under a good routing system, and plenty of good tools of standard shape and properly hardened, the efficiency of the average shop would be increased probably 33⅓ per cent. This question will be dealt with later, but reference may be made to my articles upon stock system routing and stock tracing—in which particular emphasis is laid upon the stock tracer, his work, and his authority—and upon inspection, etc., in The Engineering Magazine, May, June, 1902.

2.—The stock must be so placed as to be most easily reached or handled by the workman. This presupposes a *standard place* for the

stock. In the case of large, heavy pieces, standard handling devices must be provided.

3.—The clamping devices must be simple, effective, and *standard*, and must be supplied to the workman before he is ready to start. Much study may be given profitably to this point.

4.—The tools must be *standard* in every respect, ground to proper shapes and must be supplied to the workman before he is ready to start his work.

5.—The jigs, fixtures, punches, dies, gauges, etc., must be so designed as to be handled easily, quickly, and accurately, and must be at the workman's side before he is ready to begin work upon his new job. Much profitable study can be given to the question of proper tools. These tools and gauges must be inspected for accuracy regularly so that the foreman and workman may have full confidence in them.

6.—All stock coming into a department from some other department *must be inspected* before it is placed upon the department platform. Whether the work is large or small, inspection is absolutely necessary. For further details on this matter it may prove of interest to note the rather full treatment of the subject of inspection in my articles appearing in The Engineering Magazine in 1902.

Full mention is made of the requirements at this point for, while some of them are far removed from the single problem of machining, they still form a most vital part of the "time required to complete a job," and most certainly no "standard" or "shortest" time can ever be reached unless they are considered and *standard methods* in each case installed. And again they must be considered when we attempt to set a "standard time" upon assembling jobs.

Chapter IX.

STANDARD TIMES FOR HANDLING THE WORK.

GRANTING that the six requirements stipulated in the preceding chapter have been fulfilled—that is, that stock is provided in ample quantity, that standard places are provided, standard clamping devices, tools, jigs and fixtures introduced, and inspection established—we next come to the consideration of:—

1.—The time required to handle the part or parts.

2.—The time required to "set up" the job.

3.—The time required to machine the work (to gauge or drawing).

4.—The time required to remove the work.

In making any study of the time required on these different parts of a job, an accurate stop watch should be used. One with two hands, either of which may be stopped while the other continues to run, is the best type. It is especially valuable in noting the time required for some particular portion of the work itself, by stopping one of the hands and then noting the actual time lost between the essential portions of the operations as shown by the elapsed time indicated by stoppage of the other hand. This is particularly useful in noting the operations of assembling. Some uniform tabulation in recording experiments or conclusions should be used from the start. The records submitted are suggestive only, but contain the essential points. The proper forms must be evolved for each case. Features non-essential in one concern may be very important in another; e. g., "setting up," a job which in some types of manufacturing may be relatively important, while in others it is a very simple one. The same statement can be made with especial emphasis in regard to machining,

particularly as regards the production of stock on automatic machines, such as screw machines, or semi-automatics, such as turret lathes.

The Determination of Handling Time.

The time required to handle the parts is an important consideration, whether the tool be a lathe, planer, mill punch press, or drill press. An astonishingly large proportion of lost time can be attributed to lack of proper facilities for handling work, lack of methods in handling it, and the tendency of the workman to kill time during the period which offers so good an opportunity. In the case of heavy work it will always pay to have good hoisting and handling facilities over each tool. They may take the form of compressed-air hoists or an overhead single track carrying an electric hoist serving a number of machines—a very economical arrangement. In some cases the use of specially designed magnetic hoists will greatly facilitate such work. Close attention should be paid to the clamping devices, so that little time will be lost in attaching to or loosening from the part. A carefully considered and *standard method* of piling or placing the parts will often enable this clamping to be done very quickly.

In the handling of light work there are several points of importance that must be considered.

Wherever possible the stock should be carried in boxes. These boxes should be standardized so that as few sizes as possible need be used. They should contain tin pockets on the side in which the necessary cards can be placed. In many cases it pays to arrange the boxes with movable shelves so that the stock can not only be easily handled but can be much better protected in carrying it through the shop. Stock requiring close work is often injured through bruising. Again, such a method makes the removal of the stock from the box by both the machine hand and the inspector much simpler.

Careful judgment should be used in selecting the place where the box shall stand. Very often a low, strong table about the height of the ordinary hand truck will be found advisable. The use of this table

TESTING RECORDS.

Date — Name or No. of Part
Machine Tool — Classification
Cutting Tool — Quality of Metal
No. of parts tested
Setting Up Time (analyzed).

No. of Parts	Handling Time	Depth Cut	Feed	Cutting Speed	Test No.	Time of Test	Condition of Cutting Tool	Condition of Machine Tool	Quality of Work	GENERAL

Standard Time for Setting Up (see instructions)
Standard Time for Handling Parts (see instructions)
Standard Depth of Cut_____
Standard Feed_____
Standard Cutting Speed_____

Note. Tool to be so speeded that cutting tools will require regrinding at the end of $1\frac{1}{2}$ hrs. run if limitations of machine tools will permit.

FORM SUITABLE FOR TESTING RECORDS.

immediately standardizes the spot where the stock shall be placed, makes it easier for the truckers to handle the boxes, and, in addition to this, saves the work and time of the machine hand in stooping over to pick the parts out of the box. The placing of these boxes in the same position each time—the fact that the workman becomes accus-

tomed to finding his stock always in the same spot—adds appreciably to the speed of handling.

In the space beneath this table there can usually be placed an additional shelf to contain the tool boxes for the different jobs which will be apportioned to the workman.

If this rule of carefully standardizing the place before each machine where stock is to be placed is adopted, the question of determining the handling time becomes comparatively simple. A series of stop-watch tests upon a quick-moving workman will usually be found to be sufficiently accurate. It is well, however, to check this up by actual trial on the part of the tester. Full data relative to each test should invariably be placed upon the record cards.

Setting-up Time.

The "setting" up of jobs on lathes, planers, shapers, milling machines, punch presses, drill presses is so varied that no set rules can be laid down relative to it. A close study of all the conditions under each classification of work is very necessary. Tests should be made with stop-watch observations covering each portion of the setting-up job. When this is first attempted, it will be found almost invariably that the clamping devices for the different tools can be very greatly improved.

If the time of the ordinary workman in setting up certain jobs is noted carefully, and then the same jobs are selected for analyses, very surprising differences between the time that he has required and the time that should be required will be found to exist. It being out of the question for any one man to determine the best methods of procedure in the setting up of jobs, it is therefore wise to submit this entire matter to the Tool Room Committee, calling in to such meetings the several foremen and assistant foremen whose departments are affected. The mere fact of calling men in for such important discussions will lead not only to correct conclusions, but will also act as a spur on them toward the improving of the setting-up con-

ditions on the machines in their several departments. In fact, I am in favor of special men to set up work requiring a particular degree of accuracy. This is particularly so in the case of fine punch-press, die, and milling work. A full record of all the analyses of setting-up time should be made upon cards at the time of each test.

Time for Handling Work on the Machine Tools.

In the case of large work on lathes and planers, the time of handling the work on the machine tool is of minor importance, inasmuch as the work remains fixed until the machining operations are performed upon it. Conditions, however, are different in the case of drill-press work and punch-press work.

The handling of heavy work under a drill press, where a number of holes have to be drilled at different points in the piece of work, becomes quite a problem. Of course, radial drills are in most cases used for such work. In my opinion, however, the average modern radial drill is not built strongly enough to withstand the heavy work which can be secured from a high-grade, high-speed drill if it is pushed to the limit. Better results will be obtained by the construction of a heavy drill press, with stationary overhanging arm, the work to be moved upon a double-acting table having two movements, one at right angles to the other.

Rapid drilling in a shop is very necessary. It is, of course, important from the standpoint of economy in drilling, but the main feature to be considered is the fact that when work is sent to the drills, nine times out of ten it is then in steady progress of manufacture throughout the shop and under ordinary conditions, some one group of workmen will be found waiting for the drilling operations to be finished. This waiting may not be at all apparent, for the workmen themselves are very careful to conceal any such fact; but undoubtedly much time is lost in the average shop because of lack of high speed in the drilling operations.

Whatever device is adopted for the handling of work, very care-

ful observation should be taken in order to determine the actual time lost in this manner. In punch-press work this handling time becomes even more important, inasmuch as in innumerable cases there are a number of holes to be punched in one plate or strip of metal. A very close study can profitably be made of the proper types of movable tables with indexes and positive stops. In fact, with a carefully designed series of stops for the different classes of work, a great deal of time ordinarily consumed in laying off the holes for punching can be saved. The use of such devices also insures greater accuracy in the punching. Ordinarily, the work of the punch-press operator is not as accurate as it should be, especially on heavy work. Where this inaccuracy exists, it causes an immense amount of trouble throughout the shop.

In the turning out of small parts, the question of handling time becomes of paramount importance. The amount of time consumed, for instance, in placing small work in a drilling jig, clamping the jig, handling the jig, and taking work out, will often be two or even three times the time required to do the actual machining operation. Therefore a close study should be made, first, of the character of these special tools, with a view to reducing to a minimum the handling time of the work and to replacing any tools which require an excessive amount of such time. Granting that the tools are all that they should be, a study of the time that should be taken by an expert workman then becomes important. This can be settled by stop-watch observations and by tests. All data covering such points should be recorded immediately.

Time for Machining Operations.

This time can be determined from the tables herewith presented, by the Committee and the tester together with the foremen and assistant foremen of the departments interested. Then this determination of time should be checked up upon each piece representing each classification by actually trying out the job as an object lesson, if for no

other reason. Later, the proper machining time for the parts under each classification can be determined from the tables themselves.

My reason for strongly recommending Committee action in conjunction with the foremen will be discussed later, but a moment's thought at this point will show that this line of procedure will force the obstinate recalcitrant foreman into line in a hurry. He *must* give his support to the line of action. He is helpless as far as opposition is concerned. Furthermore, an improvement in the several departments under each foreman's supervision will become evident almost immediately. I consider this joint Committee action as absolutely necessary to the success of the plan. Always keep in mind that a speed boss or tester will be in a position to *prove* that work can be done within the specified time. Keep in mind however that it is always necessary to correct promptly any errors that may occur and that the workmen can demonstrate do exist.

Time for Removing Work from Machine Tools.

If the problem of handling the work originally is properly solved, the further problem of determining the proper time to be taken in removing work will be solved. The same problem of simple and effective clamps and efficient methods of hoisting and lowering work appear here. It is, however, necessary to emphasize the necessity for piling the work on the floor or on platforms in such a manner that it can be easily handled by the moving trucks. In the handling of light work it will often pay to give considerable attention to the problem how best to put the work into the boxes so as to facilitate its handling, to protect it from being marred, to facilitate inspection, and to make it easy for the next operator to handle it promptly. The relative importance of these different operations, however, varies very greatly according to the character of the work. What may be the most important feature of one class of work becomes almost a non-essential in another class.

Chapter X.

STANDARD TIMES FOR ASSEMBLING.

THE study of the proper time in which to do assembling work is peculiarly difficult. It is a far more puzzling proposition than the one of analyzing and determining the proper time in which any particular part should be machined. The element of human judgment and human skill enters so largely into assembling that even the closest study will at times fail to give an altogether scientific analysis of the quickest time in which any particular job should be performed. After a workman has been on an assembling job for a number of years, his operations become automatic and can be made at a rate of speed that cannot be equalled by any man whom the superintendent may elect to "try out" the job, unless he has had almost an equal term of experience. A study with the stop watch of the length of time required by the workman will often prove almost fruitless, because if the man has the slightest suspicion that he is being checked up, he will immediately slow his pace. If the job is already on piece work, the proposition becomes an especially difficult one, for the workman well knows how to keep down his rate of production while apparently keeping up a high rate of speed. It is for this reason that the study of assembling work requires particular care and especially keen analysis.

Space prevents any discussion of the essential features of the proper organization of an assembling room at this point. I will, however, emphasize the important feature that in the assembling of articles composed of many intricate parts it is highly advisable to separate the assembling operations for any particular job into as small a number as possible. If the workman can be confined to two,

or at the most three, operations the problem is not a difficult one; but where, as in many cases, the assembler will have from eight to ten different operations on a particular part, the solution becomes very difficult to find. Because of this very difficulty, it becomes of extreme importance that some solution be reached, as the waste of time in the ordinary assembling department of the average manufacturing concern is almost beyond belief. The only method of procedure that I have made a success of is as follows:

1.—Classify all the work, as was suggested in the case of those parts which are to be machined.

2.—Select the most skilful workman in whom you can have confidence. It will be necessary to make him an assistant foreman and hold forth to him promise of future promotion, if the desired results are to be secured. This removes him from the influence of the workmen and has a direct effect upon the problem. The workmen will rarely resent a thorough investigation made by a man under the title of assistant foreman, but will invariably bring severe pressure to bear upon the ordinary workman who attempts such work, in order to force him to use the lowest pace possible without detection.

3.—Place before the Committee, the testing assemblers, and the head of the assembling room, the different jobs as classified and analyze their elements to the last degree.

4.—It would be well at this point to make some close observations upon the workmen who are engaged on this work. It will, however, be necessary to use the stop watch skilfully so that the time required to perform the elements of each operation can be recorded as far as may be possible. With the calculated analyses of the elements of the work, and the actual record as made by the workman, before the Committee, it is then necessary to plan a comprehensive method to be pursued in the testing of the work and in the regular assembling operations to be done by the assembling department in the future.

It will very often be found wise and, in fact necessary to classify the work on the separate jobs in a different manner from that ordi-

narily pursued, so that each assembler will perform only a portion of the work that he formerly did in its entirety. This action makes it easier to demonstrate to the men that the work can be done within the specified time and also assists in putting it beyond their power to conceal the best results obtainable.

5.—In making these tests, it is, of course, essential to surround the tester with the best possible conditions. It is, however, necessary to keep in mind that your assembling room must be so arranged that the same conditions can prevail in everyday manufacture. These conditions may be specified as follows:

a. All the work should come to the tester or the assembler properly inspected so that the accuracy of the previous operations can be assured.

b. All the parts that are to be assembled must be conveniently arranged in logical order. All necessary rivets and screws and tools of all descriptions must be placed at a point convenient to the workman and within his reach so that the least amount of effort is required to handle them.

c. Wherever possible inspection should provide for such accuracy of parts as to make it unnecessary for the assembler to do any filing or fitting. In every case, however, where such fitting, grinding, or drilling has to be done by the assembler, the necessary machinery for doing the work must be placed as conveniently as possible.

d. Every possible facility should be provided for the quick handling of the work. In the case of heavy parts, there should be a thorough system of hoists and cranes. The stipulations outlined under the heading of "Handling of Work" will apply here.

A very careful consideration of all of these problems and a serious attempt to solve them scientifically will bring surprising results.

I have often noted very large savings in time in assembling operations, which apparently were performed by workmen at a very high rate of speed, working under the piece-work system. A few examples

of the benefits of the system advocated, taken from my own experience, may prove of interest at this point.

A few months ago, I witnessed an assembling job, the work of which was done according to methods which had been developed under a careful study along the lines advocated. The piece-work price on the assembling work had formerly been $2.85 per piece. The application of these newer methods made it possible for the workman to do the entire assembling job in 16 minutes, and this, too, at a pace which it is perfectly possible for him to maintain during his entire working period.

Some four years ago, I made comprehensive tests in a very large establishment on assembling work requiring a particular degree of expertness and dexterity. Inasmuch as it was impossible to secure one of the trained workmen (numbering in all over 150) who would give his very best efforts to any job that might be set before him, I took a man who was an ordinary truckman, who had never been a mechanic in any sense of the word, and trained him for a period of five weeks before we started him to doing the testing. We naturally selected a man who was particularly bright and capable. I do, however, want to emphasize the point that this particular individual was not a trained mechanic and secured what skill he possessed only during the five weeks training mentioned above.

Allowing that each workman should earn on the average of $3.00 a day, we found that there were 286 jobs that averaged 167 per cent. too high. In other words, for every job that formerly cost $1.00 on piece work, we found the proper price to be about 38 cents. Even then the limit had not been reached, because of the fact that the man who was doing the work could not be termed the highest grade of mechanic. We found, however, that after six months had elapsed, he could easily earn $4.00 a day at the prices on the new basis, whereas his former earning had been $3.00 a day. Further investigation showed that in this establishment, where 4,700 men were employed, there were a number of departments where the work was quite sim-

ilar but where the piece-work prices were all out of proportion, those in one department being greatly in excess of the prices in other departments doing similar work, this being due to the relative efficiency or inefficiency of the foremen in setting prices. We found upon the average that this disproportion amounted to over 23 per cent. The tests mentioned above were performed in one of the departments which was considered the most efficient. In another department—a large polishing room containing 123 men—I found another field for work of the character advocated. These polishers were supposed to be very high grade, their average earning capacity being $4.00 a day.

The grinding, polishing and buffing included work upon brass, bronze, copper, sheet steel, and cast iron. After the work of investigation had been under way but a short time, a strike occurred. All of the old polishers left in a body. We secured a group of 12 expert polishers from other sections of the country, and then, by offering a high day-work wage rate, we employed 62 men from the adjoining city. It is important to note that these last were men who had never been "up against" a polishing or buffing wheel, and knew absolutely nothing about the trade. Some were clerks from the company's office and others were grocery and dry-goods clerks attracted by the high wage rate. Care was exercised to see that they were strong, healthy and intelligent. Each experienced polisher was placed in complete charge of a group of five of these "green" men. This experienced polisher was under no circumstances allowed to do the work himself, other than to show these men how to do the work and to train them in every possible trick of the trade. Extra rewards were given to these experts to get proper results from the men. In addition to this, the foreman and assistant foreman of the department, together with the writer, were in constant attendance. Unfortunately, my investigation of the elements of this work had been so handicapped by the extra work incidental to the strike that it was impossible to analyze each and every job in the department. The analyses already made, however, showed that a reduction of 40 per cent could easily be made

and still provide the men with a large enough price to enable them to earn a good wage. It was our original intention to place the new men upon a day-work system of pay for a period of about eight weeks, the management presuming that very slow progress would be made for this period at the very least, many of the officers indeed claiming that proper results could never be accomplished.

The analyses of operations and the method of training was pursued so vigorously, however, that we found it possible to put the entire body of men upon piece work at the end of three weeks and a half. The new piece-work prices (40 per cent lower than the old ones) were given to these "green" men with the assurance that there would be no reductions made and that the firm would be glad to have them make all the money they could during that period.

The management was careful to see that the former rigid system of inspection was still adhered to in the case of these new men. It is a matter of record that at the end of a period of ten weeks the average earnings of the men of the department exceeded $5.50 per day. The work increased so materially that at the end of six months the actual records showed savings in the pay roll in this department amounting to over $55,000 per year.

Had there been time to make a closer time study, it would have been possible for the firm to save even a larger amount of money with the additional assurance to the workman that he would still have been able to earn a large wage.

These few examples will serve to illustrate the splendid possibilities of the methods and systems advocated.

I shall take up later the question of the system of pay to be used in case of a shop adopting systems described in this book. It is sufficient to say at this point that I regard it as *absolutely essential that a workman receive a very considerable increase in his daily wage* for accomplishing the very desirable results which can be secured. My object in mentioning this just now is to emphasize the fact that even with the best analyses a workman will become so skilful in time on an

assembling job as to exceed to quite a large degree the calculated records, and consequently, in order to secure this extra output, the possibility of which lies hidden within the workman's skill, it is necessary to offer an additional premium.

Foremen's Co-operation.

It has been remarked to me more than once that the most difficult of all the problems connected with the introduction of such systems as those advocated is that of securing the foremen's co-operation. It is undoubtedly true that unless the hearty co-operation of the men operating the departments be secured, the system is almost certain to fail. It is safe to say that it will be almost impossible to introduce these plans in any comprehensive way with a shop organized in the ordinary manner. It is for this reason that I venture continually to bring forth the effectiveness and, indeed, the necessity for the Committees. In securing the foremen's co-operation to these plans, tact must be used. Unless the matter is handled delicately, every one of them will feel that his department is going to be "shown up," and the new record will be compared against his own record to his own disadvantage. Naturally, therefore, this consideration will lead him to covertly oppose the introduction and success of the methods at every point. When, however, these matters are considered in their presence with the Tool Room Committee and the tester, together with the tabulation, they are placed in a position where they must wheel in line and give their support to the system.

By calling all of them constantly into consultation with the Committee, they are placed in a position where they cannot defend any unfair attitude toward these methods. Give them to understand that if they have anything to say in opposition to the plans the Committee room is the place to say them, and under no circumstances tolerate a word of criticism outside of the Committee room. If they are made to see that the results are obtained through new methods entirely, and that they are not to be criticized nor held responsible for the results

formerly obtained under the old conditions, they will soon lend their enthusiastic support to these plans. Let me again assure any one considering the introduction of these plans that this support is absolutely necessary.

I have always found that if this important question is handled along the lines indicated, and, in addition to this, the foremen are given to understand the success of the system would mean addition to their remuneration, their hearty co-operation will be secured.

Chapter XI.

STIMULATING PRODUCTION BY THE WAGE SYSTEM.

IN the preceding chapters methods of determining with accuracy the shortest possible time in which any job can be done were fully discussed. There I dealt with the latest tables showing the best possible cutting speeds on lathes, planers, and drill presses, and also described methods by which the shortest possible time on intricate assembling jobs can be determined. Naturally, the determination of this "shortest time"—this fixing of the "standard time"—will prove of great assistance in the collection of prime labor cost data on any and all jobs of work.

Before giving consideration to systems of cost-keeping or to the stock-keeping and stock-tracing systems which are interlocked therewith, it is important that we briefly consider the question of the wage system under which the men must work, and which to them is the all important feature of their shop life.

We manufacturers must keep in mind just what actual shop life and the wage system mean to a workman. We, who have crawled up the scale, now look upon a broader horizon of opportunity. We are not surrounded by those inexorable conditions which to a large extent absolutely regulate the life of the average workman. We are not subject to the whim of a job boss or assistant foreman, who holds his place perchance through favoritism or relationship to someone in power, and who looks with frowning mien upon any improvement which might be suggested and for which he may not get the credit; whose control over five-twelfths of daily existence is well-nigh absolute; who can make the daily work easy or hard, the daily earnings for the all important livelihood large or small, by apportioning the

work unfairly. We are not compelled to work under a system of pay that provides no especial recompense for extra effort and extraordinary output, but which on the other hand often rewards (?) extra thought and extra skill and effort by a cut in the rate or "price," which leaves one working, perhaps, 20 per-cent harder than a few days before with a daily return in wages no larger than formerly—our job boss or foreman adding to the "pleasure of the incident" by proudly showing how he "cut that price 20 per cent, saved the company a large sum of money, and still 'gets the output.' "

Much has been written upon the subject of systems of pay and many broadsides have been fired at the old system of piece work, *coupled as it so often is with the practice of cutting rates when the men begin to earn large wages.* But it is far from being blown out of existence, for today the majority of factory managers still adhere to these methods. Understand me, I do not criticize the piece-work system *per se,* but I do strongly condemn, as unfair and uneconomical, the habit of cutting of rates when wages become high which almost invariably accompanies the system. In fact, I have found the same tendency to exist in the case of the premium and other systems of pay, in some cases. The mischief is very largely caused by the practice of setting "original prices" or "original times," not based upon data scientifically determined, but upon "best previous records," an ordinary "try out" or, worst of all, the foreman's estimate. It is because of the importance of the system of pay and because of the inefficiency of the ordinary methods that I have tried, in the preceding paper, to lay down some principles or rules that may be a guide in securing proper results and in giving us a secure and accurate foundation upon which to build our structure of proper factory management.

We must ever keep in mind that recompense to the workman is only one part of our total cost. A largely increased production per square foot of floor area means lower cost through the decreased proportion of overhead or indirect cost per piece. Further, it means

a much quicker movement of stock and thus a release of working capital through reduction of investment in stock. It means better satisfaction to selling department and customer through quicker deliveries, and almost invariably an increase in sales with a heavy decrease in cost of selling per article. The average factory manager will term this far-fetched; but any man who has reorganized a completely run-down concern, and built up the manufacturing, selling, and financial ends of a business, knows that there is nothing so vitally important to the success of the business, in every direction, as the quickening of shop production and the possibility thus secured of making a quicker turn-over of working capital invested. The average factory manager gives little thought to this, but the financial officers and backers spend many worried hours trying to make both ends meet and wondering "where all the money goes."

The Wage Problem in Introducing Standard Times.

We may be sure that, having collected all of our data relative to standard times, we still have before us the problem how to introduce these—how to persuade the workmen to work to them, or in shop phraseology, to "stand for them." For you may be certain that if the work of determining these times is done accurately and thoroughly, the figures obtained will be so far below the results actually being secured in existing shop practice, that the workmen will, in all honesty, refuse to believe that it is possible to attain such rates of production; and indeed, we too must keep in mind that the attainment of these standard times does not depend wholly upon the workmen, but very largely depends upon the efficiency of the factory management itself in many directions, such as supplying plenty of tools of standard shapes and hardness, proper machine tools and fixtures, and stock properly placed, as well as a method of instructions and demonstrations how the work should and can be done.

It is perfectly obvious that not every workman can possibly attain for some time the rate of speed necessary to do the work within

the set time limits. It is equally clear that it is immensely to the benefit of the manufacturer for him to get the working time down to the points determined upon. A flat piece rate based upon these times is manifestly unfair, and an attempt to introduce such rates would probably lead to immediate trouble with the men. I am strongly opposed to any plan that does not provide some form of extra reward to the man for attaining the standard time, this form of reward or bonus to be assured to him with the guarantee that no reductions will be made unless methods, process, or tools be changed.

The method of pay and character of the reward will depend upon the character of the business and the method of pay already in use. I have never favored the forcing of any preconceived plan of any character upon a factory organization or system, if it carries with it the necessity for ripping up existing methods and plans that have become a part of the factory's very daily existence. The old method, the old systems, possess a momentum that cannot be overcome. So, repeatedly, have I seen the modern systematizer enter the shop organization, upset the existing methods, put in his own pretty theories, only to find, upon returning six or nine months later, that the momentum of the old methods, devised by men who learned the shop's necessities through long and bitter experience, had been too much for his plans and that everything he had done had been, in some inexplicable manner, swallowed up and absorbed by the rolling old system. 'Tis only the theorizer, the man who has not "been through the mill" and who knows not the innermost recesses of the shop processes and cannot read the hidden thoughts and feelings of the members of a shop organization, who rashly promises to "put in a system that will revolutionize the shop and bring up its efficiency."

Rather study carefully the character of the work, the ability of the foremen and workmen, and the systems already in use, and then begin to adapt the new methods to the old—apparently deduce the new methods from the old—and you will have the intelligent support of the organization. And that support that will mean progression to

newer fields of thought and activities, and not retrogression to the older methods.

These remarks, fundamental in their importance, apply with particular force to the determination of the wage system to be adopted. The principle of extra bonus or the attainment of standard time can be easily applied to almost any system of pay. Where it cannot be applied directly, the transition to a proper system is usually not difficult.

Systems of Pay.

The most prominent systems of pay in the United States are discussed below. In England there are many different plans, but these cited herein represent the most prominent in use today.

Day-Work Plan.—This plan, usually decidedly inefficient unless under special conditions, can be easily changed to a most efficient one by applying the bonus idea advanced by Mr. Gantt.

Piece Work.—By this the workman receives a certain amount of pay per piece. A very mischievous plan if it be accompanied by the continual cutting of rates. It cannot be considered efficient when the rates are established according to methods usually practised.

Premium Plan.—An efficient plan on many classes of work. The determination of standard times should, however, be made carefully. If the rates are determined by other methods the plan will eventually fail.

The Differential Plan.—Developed by Mr. F. W. Taylor, of Philadelphia; the piece price varies according to the rate of production. The greater the number of pieces turned out in a given time, the higher the piece price. This can be applied when the "intensity or rate of production" must be high in order to get the utmost out of very costly machinery, tools, etc.

The Bonus Plan.—Explained in detail by Mr. Gantt in his valuable paper read before the A. S. M. E. in December, 1901. Distinctly a system of task work combined with the use of instruction cards for

the workmen and a bonus for accomplishing the task within the time set for it.

This bonus system of pay has always appealed to me as the most easily understood, the easiest to introduce with little opposition, and the most effective of all systems yet produced. It is adaptable in some form to almost any other system of pay that may be already in existence in the shop. It is the easiest to introduce in case the men are working upon the day-work basis. Nor is it difficult to persuade the workmen to abandon piece work for it in case the reward is made sufficient. I have been introducing it into works under my control with marked success.

It is of interest to note here, however, that even the closest analysis and study of the possibilities of assembling operation of great intricacy, such as the assembling of the counting mechanism of high-grade adding machines and cash registers, failed to give a positive indication of the possibilities of output in the case of a highly expert workman. The time of actual tests of the intricate assembling when made by the special tester fell far short of the time that could be easily maintained by the workman who, through years of repetitive processes, had gained marvelous skill. The study of his movements by a stop-watch expert would often show but little as regards the possibilities of increasing the speed of the essential operation, though expert observation will probably show that much can be gained by arranging the stock and tools properly and providing ample quantities of stock properly inspected for quality. But the skilled assembler can and will deceive anyone not of the highest order of expertness concerning his possible rate of production, particularly when he has worked for years in the assembling of small parts of great intricacy and where great accuracy is necessary. Therefore, I applied a simple plan of offering the men an additional bonus for every half-hour they gained, in the form of an increase (carefully proportioned according to the length of the job) to their half-hourly wage rate.

I am distinctly in favor of the bonus plan of pay when combined

with methods that determine accurately the shortest time in which a job can be finished. It should include a bonus plan for the job bosses and the foremen by which they secure bonuses in case all the men under them earn bonuses. This will result in the foremen immediately giving their close attention to the inefficient workman for his proper and speedy training or his discharge.

Chapter XII

STOCK AND COST SYSTEMS AS A FACTOR IN PROFIT-MAKING.

MUCH has already been written of stock and cost systems, the subject having been thoroughly covered by a number of able writers and managers. I will not attempt to go into detail and describe any particular cost system, for that has already been well done. Besides, as already stated, each business presents its individual problems so that it is better to consider the adaptation of certain fundamental principles to existing conditions rather than to describe a fully developed system with the thought that it can be transplanted in its entirety to any other factory.

In fact, I shall not attempt within the confines of this chapter to discuss the theory of cost keeping, nor shall I deal with the problems of distribution of overhead or indirect charges. Rather shall I confine my attention to a description of a very simple and yet effective system of prime-cost keeping combined with the important stock-keeping and stock-tracing systems, which in actual practical use has proven of great value in a number of concerns when properly adapted to existing conditions.

To my mind a cost system should primarily be so devised as to give the manufacturer an accurate knowledge of his *most costly and expensive operations*, so that he may know unerringly these "high spots" and attack them vigorously. With this knowledge he can then devise various ways and methods of reducing costs. Without it he is well-nigh powerless. His stock system should enable him to keep down his investment to a minimum. His stock-tracing system should prove a most effective means of getting his stock through his factory

rapidly and without delays. In other words, the practical value of these systems as thoroughly effective methods with which to locate the "inefficient spots," and through which to attack those operations or methods which are excessively costly, outweighs the importance of the theoretical securing of costs simply in order to determine the selling price. The cost system should provide a club with which to beat down costs—the stock-tracing system another club to drive the factory rapidly and economically. Therefore, the stock system, stock-tracing system, and cost systems are so interrelated as to make it impossible to consider one without the other.

Keeping of Raw Stock.

The stock-invoice card illustrated on the next page will show clearly the nature of the data required to keep such records properly. The problems involved are:—

1.—The keeping on hand of sufficient raw stock.
2.—The placing in the factory of proper amounts of stock for manufacturing purposes.
3.—The keeping on hand of proper amounts of finished parts for assembling.

In cases where work is ordered wholly on special contracts, and special material ordered from outside manufacturers, the same simple system can be used with modifications and will prove of equal, if indeed not greater, importance; for in such cases some method by which special raw stock from outside manufacturers can be brought to the shop *on time* is absolutely necessary.

Necessarily the first form is the Requisition for Stock. This is so uniformly used as not to need illustration. It forms, however, a very important and necessary link to the chain.

The next important form is the Stock-Invoice Card. This can be placed at each stock bin or filed in the factory office.

The most important point to note is the "order limit," or the limit at which new stock must be ordered. If it be raw stock then this

limit must be determined by giving consideration to the amount of finished stock required in finished-stock bins, the length of time required to get the stock through the factory, and the length of time required to get the stock from the manufacturers. The "rush limit" indicates a dangerous condition of affairs that must be remedied by using extra efforts. In the case of raw stock the purchasing agent *must be notified immediately and kept after* continually.

STOCK INVOICE CARD Bin No.

Name and Specifications.....

Am't Used per Mo..... Order Limit.....

Where Used..... Rush Limit.....

Date	Ordered	Received	Delivered to Factory	Order Number	Inventory	Check No.	

In order to have this simple system work properly great care must be used in making all entries promptly and properly. It will be noted that this very simple plan provides a perpetual inventory of great value in many ways. While it does not provide for the combining of factory accounts with the general accounting, still it does provide a very simple, inexpensive, and in most cases a sufficiently accurate method of keeping accounts and values. Reports of raw

stock reaching these limits must be made each night to the purchasing agent, a Special Rush List giving those that have reached the rush limit point.

In the case of the finished stock even greater care and vigor must be used. The entries having been properly made, a list giving the amounts of those items of stock which have reached the order limit is sent to the stock tracer, who can ascertain whether additional stock should be ordered or stock already ordered hurried in its course of manufacture. A separate rush list showing the amounts of items of stock which have fallen to and below the rush limit should also be given to the stock tracer for his immediate and special attention. In many cases these lists should likewise be given to the departmental foremen, as they are thereby provided with the best possible means of knowing what work to rush.

The system as described is particularly fitted for that class of manufacturing in which the work is standard and many parts can be carried in stock.

In cases where the work is upon special contracts and the work not standard, careful consideration must be given to the time within which each department must do its share of work and turn it over to the next department, calculating of course from the given delivery date of the work. This time should be entered upon the Special Stock Tracing and Cost Sheet which will be illustrated later.

All cost entries are made from the workman's time ticket. This ticket needs no description. It differs in each factory and each system of pay. It, of course, should contain:—

1.—Name of the department.
2.—Name or number of the piece.
3.—The order number and box number.
4.—Character of the operation.
5.—A full description of the amount of stock received and finished.
6.—The price or rate, and total wage.
7.—The time started and time finished.
8.—Name of workman, foreman, and inspector.

Operation	Quantity	Department	Date Del'd	Should be Finished by	Date Returned	Time Consumed		Bonus Time		Actual Labor Cost	Workman	Machine No.	No. Pieces Lost	Why	
						Hrs.	Min.	Hrs.	Min.						
Totals															

Order No._____ Material { Weight_____ / Cost_____

Name of Stock _____ Total Cost_____

Box No._____ Date_____ Should be finished by_____

THE STOCK-TRACING AND COST SHEET.

Storage Platforms.

Wherever possible it is advisable to establish storage platforms in each department. These should be of the height of the moving trucks so as to facilitate the loading and unloading. Each workman should have beside him only the job upon which he is working, and the next job upon which he is to start (with all necessary tools, gauges, clamps, fixtures, etc.). All other stock should be placed upon the platforms. The advantages are many:—

1.—The foreman and the shop management are provided with a very close idea of each department's operating condition. An excess of stock shows an unbalanced shop condition. A shortage may prove a like condition in another department, and a too large capacity in the one under observation.

2.—A foreman can thus easily apportion the work among his men so that no delays need be encountered. In addition to this he can easily collect the needed tools, gauges, fixtures, and clamps for the next job for each man—exceedingly important features.

3.—Should the foreman note that he is running short of any particular stock adapted to any of his machines, he can notify the stock tracer who can easily afford him relief by rushing other departments. This prevents the foreman from running around the shop needlessly.

4.—The stock-tracing or routing system is greatly simplified.

5.—The taking of inventories is greatly simplified.

The Stock Tracing and Cost Sheets.

All entries are made upon the Stock Tracing and Cost Sheets by the cost clerks. The rapidity with which these entries can be made by rapid clerks is remarkable. In one factory operating over four thousand men, all entries regarding immense quantities of stock were made upon these sheets by these clerks. A careful examination of this stock tracing and cost sheet shows that herein, in simple form, is

contained a full history of each lot of stock in such form as to admit of many uses.

1.—The stock tracer, notified by his date sheets from the stock clerk of any stock which is running low, can quickly determine those departments in which is located that stock which may be further along in course of manufacture. He can readily force these foremen to produce the stock to prevent delays.

2.—Delays in any department are clearly indicated.

3.—The actual time consumed and the labor cost on each operation are closely indicated. There is provided an analysis that will prove of great value in the hands of one who will systematically hunt for the most costly points in production, with the object of devising tools or methods by which cost reductions can be made. The value of this record in inventories is apparent.

4.—Each workman is clearly linked up with his operation. The columns showing "Loss" will provide an index to the efficient men.

5.—The data relative to weight and value of raw stock may of course, be adapted to conditions. Whatever the plan pursued it may be very simple. We are thus easily provided with a prime-cost record of great value in devising cost reduction, and in the making of it we are provided with a full stock-tracing system.

As before stated, I shall not attempt to discuss the question of the overhead or indirect charge as this has already been dealt with fully, my object being solely to present a simple and adaptable system which will include the solution to all of the practical problems to be met with in manufacturing.

By using properly the data already upon the time ticket or stock tracing and cost sheet, supplementary reports of value can be made up such as:—

1.—The individual workman's record, showing each man's record on each job.

2.—The job record, showing the job time and cost record for each workman.

3.—The departmental efficiency record, in which output, number of employees, pay roll, and costs are compared.

4.—General factory output and efficiency record, showing comparison of output, hours work, pay rolls, and costs comparing one period (either months or years) with one another.

A factory thus equipped with a cost system that will enable the manufacturer to determine the proper point of high cost to attack, with a system of determining standard times, a method of stock location and tracing by which delays are avoided, the whole supported by modern organization and management, can defy competition.

Chapter XIII.

THE UPBUILDING OF A SELLING ORGANIZATION.

IN a chapter as brief as this must be, it is, of course, out of the question to discuss at all fully the broad general question of methods of selling. Again, each business has its own peculiarities which make it necessary to apply special methods. At the same time, much can be said on that question of tremendous importance—the upbuilding of a highly trained, efficient selling force—that will be applicable to a business of any character. Different methods of making different manufactured goods make necessary some change in the plans, but in almost every case the fundamental elements are the same.

Methods of selling manufactured goods may broadly be divided into four divisions:—

First, where the goods are sold direct to the consumer by selling representatives of the manufacturing concern itself. This may be either through the company branch houses, or commission or salaried men, all of whom are employed and paid by the company. In this case, while considerable working capital is tied up and the stock of goods must be heavy, at the same time the selling division is directly under the control of the management and the territories themselves secure a company representation possible in no other way.

Second, selling to exclusive agencies, who themselves employ salesmen to deal direct with the consumer This plan has much merit, although it is often difficult to devise plans whereby the agencies themselves may be forced to cover their territories and to develop an efficient selling department. It is also important to notice here that in such cases the manufacturing company very often does not come into close contact with the individual members of the

selling division of such agencies, and thus their methods are not properly impressed upon the men. A connecting bond between such agency salesmen and the manufacturing concern is of great importance. This becomes especially so in cases of sudden terminations of contract, etc.

Third, selling to jobbers. This plan is susceptible of such variety that it hardly needs consideration. Close connection between the jobber and the manufacturing company is very necessary. Constant and skilful attention must be paid him in order to secure adequate and permanent representation.

Fourth, direct advertising, selling by catalogues, etc. A discussion of this method of marketing product need not be considered here.

Whatever the business, whatever the method of selling, the importance of a highly trained efficient selling division stands out paramount. In developing a selling force, we must consider:—

1.—Training of salesmen.

2.—Training of sales managers.

3.—Developing of a proper system, whereby both salesman and sales manager can be properly checked up—the former, to ascertain if he is properly covering his territory, and getting his full quota of business, securing proper prices and terms, and keeping his old and new customers satisfied; the latter, to see if he has the proper grade of salesmen employed, proper control over them, proper methods of training them; also to note if he is securing an adequate volume of business at such prices and with such economy in operating expenses as to guarantee a sufficient profit.

Training of Salesmen.

Singularly enough, the majority of concerns today spend tens of thousands of dollars in advertising and in forcing the attention of the public upon their goods—in "creating the demand"—and yet they fail to train their sales employees—the men and women upon

whom they must absolutely and finally depend as "closers"—so that they may know the "talking points" of their goods, the best methods of presenting their arguments, and the surest methods of finally "clinching the order." The unknowing sales manager often dismisses the argument in favor of training of the salesmen with the trite remark "salesmen are born, not made." A mischievous belief! Granted that some men are by nature better fitted for selling than others, those men are only too few. Training would surely improve their efficiency. Unfortunately, however, we manufacturers who market our own goods can find but very few of these "born salesmen," and are obliged to rely upon the "average salesman" for the most of our business getting. Such being the fact, it must be apparent that the average selling division needs badly a scientific and systematic method of training, in order that the large proportion of "average salesmen" may be brought to as high a degree of efficiency as possible. Nor does the advantage to be reaped stop simply with the training of the employees in selling. The meetings which this system calls for, if managed aright, are sure to prove of immense benefit in arousing a healthy and stimulating enthusiasm in the employees affected. An honest desire and intent on the part of these salesmen to "put in the best licks for the House" gives an impulse to their activities that nothing else can supply. This feeling can be instilled into them by a skillful, tactful sales manager. Do not forget that a sullen, listless, or disloyal member of your selling force affects your profits immediately. If you have many such, your department is costly and inefficient. The effect of your thousands spent on advertising is nullified by such conditions. On the other hand, a highly trained, loyal, interested and active selling force is one of the most valuable assets a firm can possess. That such a selling organization can be developed, even from one of a peculiar degree of inefficiency, has been proven by a long personal experience in several lines of business and very close observation of the results obtained in other modern business concerns.

John H. Patterson, the brilliant president of the National Cash Register Company of Dayton, Ohio, was the first business man to grasp the possibilities that lie in the training of the salesman. Through his genius, his company has developed probably the greatest and most efficient selling organization in the business world today. His example has been followed in the manufacturing business by such concerns as the Burroughs Adding Machine Company and the Herring-Hall-Marvin Safe Company, with decided success. Work of this character has been successfully applied to "Hapgoods," the firm doing a large employment business. Indeed, its essential principles can be adapted to the conditions of a business of any character in which the marketing of goods plays a large part.

Development of a Selling System.

While each business requires special study and special methods, the general plans of the "Science of a Selling System" can be clearly pointed out so that they may be adapted. The two essential features of this system are "Salesmen's Demonstration Meetings" and "Salesmen's Training Department." While the "Salesmen's Training Department" is in fact the more important feature, I place the "Salesmen's Demonstration Meetings" first, because the training department is, nine times out of ten, the outgrowth of the demonstration meetings. The logical beginning of this system is with these meetings, because the points to be used in the training department are invariably secured from the discussions arising in these meetings. Again, these meetings serve as a gradual introduction for the later training department, and so accustom the selling force to the methods themselves that there arises but little opposition to the training department when it is first proposed. Each salesman, too, feels that he has had some part in the development of the training department, inasmuch as his own arguments are often used, and so thorough support can be elicited in place of the violent opposition that may be expected if any arbitrary methods are used. Woe betide the sales

manager and the sales system if he starts at the "other end of the line," and attempts to force these methods upon his selling department before the members are ready for it.

Salesmen's Weekly Demonstration Meetings.

The points that will be brought out in regard to these meetings need no elaboration, as their merit is self-evident.

First, a time for these meetings must be set and constant attendance insisted upon. The sales manager must invariably be present and take part in discussions of all matters of importance. If possible, some higher official should be present once a month, in order to inject a new interest and new quality of enthusiasm into the salesmen. It will stir up both salesmen and sales manager tremendously if they are compelled to exhibit before someone high in authority.

Second, it must be kept in mind that these meetings are for the training of the salesmen (and incidentally the manager) and helping them over their difficulties, for arousing interest and enthusiasm, for giving the salesmen a chance to "blow off steam" on any trouble they may have that is affecting their efficiency, and for securing from them suggestions for the improvement of the business. A sample weekly programme follows:

Programme of Salesmen's Demonstration Meeting.

1.—Announcements. By Sales Manager.
2.—Description of new products and fields they are designed to fill. By Sales Manager. (Suggestions and criticisms from salesmen requested.)
3.—Demonstration of salesmanship. By Salesman—J. H. Smith.
By Customer—G. R. Brown (Salesman).
Censors—R. Fowler, H. White.
(a) Selling the product to the customer whose business is carefully selected and who desires a good article.
or (b) Selling customer asking for low-priced article, a higher-priced and more profitable product.
or (c) Selling second-hand product to customer.
or (d) Selling customer asking for second-hand product a new product.

or (e) Selling customer new product, taking old product in exchange, at profitable allowance figure.

or (f) Selling customer against strong competition, another salesman entering the demonstration as competitor's salesman.

NOTE: These demonstrations may be varied by having the same points illustrated as "Company-office Sales," where all stock and other paraphernalia are present, or as sales at the customer's office, where the salesman must depend upon illustrations, samples and catalogs.

4.—Discussion of demonstration, first, by the appointed censors, Fowler and White, and second, by each salesman personally.

5.—Discussion of week's business; why individual salesmen have not made their quota of sales and difficulties met by salesmen, from blackboard individual-sales record and from individual-sales reports.

6.—A talk by the sales manager or some high-grade salesman on general important points of salesmanship, such as:

Investigation of prospective customer's business and his methods.

The proper "lining up" of selling arguments so that the "selling climax" may come at the right time.

Methods of introduction, or "the approach."

Methods of getting the prospective customer's attention and making demonstrating arguments.

Methods of using closing arguments and "getting the signature to the order."

Ways to meet certain arguments and objections of prospective customer.

Ways to meet competitors' claims and arguments.

Methods of cultivating a territory.

Importance of "satisfied user."

Importance of "knowledge of the business."

Advantages to be gained by paying close attention to such seemingly small points as tact, dress, industry, perseverance, talking too fast or too much, answering customer's questions quickly, and a multitude of similar matters, perfection in which is so important.

7.—Discussion of different competitors' products, their talking points and how to controvert them, their defects and how to prove them.

8.—Suggestions and complaints.

9.—General subjects such as advertising, etc.

Keeping in mind the main objects of this sales system—the creation of interest and enthusiasm and the training of salesmen—an examination of the preceding suggested programme leaves an explanation almost superfluous.

In making announcements and describing new products, much can be done to create a lively interest in the company's affairs on the

part of the salesman. A frank and full discussion of new products or proposed new designs will often prevent serious mistakes and will almost invariably result in suggestions that will make the product more marketable.

The suggested variations of "Demonstrations of Salesmanship" are also self-explanatory. Note carefully the appointment of censors. It is also especially desirable to hear comments upon demonstrations from each salesman. If the sales manager handles matters right so that the salesmen enter into this programme in a proper spirit, there need be no fear of salesmen becoming angry over fair criticisms. The "customer" can be selected from the sales office. He must be given to understand that he is not to aid the salesman in any manner, direct or indirect, and that he should bring up all the arguments and objections against buying that he himself has learned from his own customers. In a business where the product covers a broad field, embracing a number of widely different kinds of business, where a discussion of the business system enters into the sales, the "customer" and the character of the business can be selected so that in the course of a short time the demonstrations will cover the entire field and a full line of argument be brought out for each line of business. The character of the business and the conditions surrounding it should be thoroughly understood before beginning. Often a salesman who has had a particularly hard nut to crack will suggest the conditions and himself act the part of customer against a good salesman, in the hope of either "stumping him" or getting some good pointers. Especial attention may well be given to methods of convincing a customer that he should purchase a higher priced and more profitable product. Inasmuch as the selling expense remains the same, or very nearly so, an effective method of accomplishing this will result in a much larger proportion of profit. The most modern concerns pay a great deal of attention to this point and have developed a highly scientific and effective method for accomplishing it. This applies also to a business in which

exchanges for old products enters into a large proportion of the sales. This is often a puzzling feature, and unless thoroughly understood reuslts in large hidden losses.

Great interest can be aroused by the introduction of a salesman representing a strong competitor, who is supposed to do his best. Such exhibitions are not only highly instructive, but also inspire salesmen with a confidence in their own goods.

It is important that two demonstrations be often given, one conducted by an old and skilful salesman and one by a newer member of the selling force. This not only aids greatly in the education of the newer salesman, but often acts as a great spur on the older man not to be outdone by the newer ones. In conducting these demonstrations care must be used to see that no slipshod methods be allowed to creep in. The "sales" must be conducted with all the dignity and formality of a real transaction from the beginning, in order that the best form of "approach" or introduction of the subject may be observed.

A better method of instilling selling confidence into a man is hard to devise. After he has had to appear several times before a body of his selling companions and his superior officers he gains confidence rapidly and his attacks of "nerves" are things of the past. Such methods quickly develop the "quitter," for his improvement or elimination from the organization. They certainly show up the "dead wood" quickly.

The talks by sales manager or high-grade salesman upon general selling points, as noted under programme item 6, will prove of great benefit to new salesmen. The points brought forth—taken by a stenographer—are of great value later when organizing a method of training. The items given embrace only a very few of the important topics that may be discussed, but are given to illustrate clearly the nature of the talk suggested.

Discussion of Competing Product.—While it is not often advisable to instruct salesmen to talk against competitors' goods, I regard it as

absolutely necessary that salesmen be thoroughly posted on the character of competitors' products. Very often true statements of defects in such articles become necessary.

Suggestions and Complaints.—This section deserves more consideration than can be given it at this point. Nothing is more vital to the progress of a company than the proper and conservative meeting of the actual market demands and the improvement of product so as, if possible, to keep ahead of the demand. No one knows the needs of the market or the advancement of competition as does the salesman. A systematic plan to secure these suggestions from the body of salesmen will prove of very great value. The same may be said regarding complaints. Legitimate complaints should be "aired," and when the causes are ascertained prompt steps taken to rectify the troubles. Many a firm today prefers to shut its "business ears and eyes" and refuses to hear of troubles or to see perfectly obvious defects which are continually having a disintegrating though hidden effect upon the business and organization.

The details of these meetings should be invariably taken down in shorthand. I have found it of great value to have sufficient copies of the proceedings of each meeting made to allow of their being distributed to the sales managers in all parts of the country.

It is important that the general sales manager consider it his particular duty to read carefully all minutes of these meetings and then to write to each local sales manager, commenting upon them, (in each case mentioning names of salesmen). The effect upon both manager and men is very beneficial.

The quality of the demonstration affords a very good proof of the calibre of the salesmen in each district and thus provides the clearest kind of an index to the quality of salesmen throughout all the points of the organization. Again, the salesmen are impelled to do their level best, knowing that the general sales manager will himself note the character of their work, even though he may be thousands of miles away. By such a simple means the influence and

power of the general sales manager will be felt throughout the entire selling organization.

Salesmen's Training Department.

While much good can be derived from such weekly meetings, the progress of the men toward high-grade selling is necessarily slow. The influence toward rational methods is not constant enough. Again, constant individual attention should be given the new men at the beginning so that they may have the full benefit of such methods early in their selling career. Experience has shown that the only rational plan for developing salesmen rapidly and upbuilding a strong homogeneous selling department is to develop a strong training department for salesmen. This department should be independent of the influence of any local sales manager, but should be under the direct supervision of the general sales manager. It should be his "selling right hand." All local managers should be thoroughly trained in this department's methods so as to supplement its activity in their own local districts. All salesmen should be trained therein. Particular attention should be paid to the export trade agencies. Some firms establish training departments in the several foreign countries. Personally, I prefer to have even representatives of export agencies taught at the home office, so that they can not only get the best possible course of instruction but also may come under the direct strong influence of the home-office executives.

The first step (and often the most difficult) is to find the proper instructor. No greater mistake can be made than to attempt to use a cheap man. This work requires a man with the widest selling experience, coupled with great tact, patience, and teaching ability; a man whom the salesmen will respect for his ability. The outline of his work will demonstrate the necessity for having a man of sterling ability.

His first work will be to prepare a "Manual" for salesmen. This must contain:

a. Strong points on general salesmanship.
b. A thorough and careful explanation of each product and its adaptation to all different lines of business.
c. An exceedingly thorough explanation of the "talking points" or "selling arguments" of each product.
d. An analysis of competitors' products and a comparison with the manufacturing company's product.
e. A careful and scientific analysis of the best methods of introduction to a prospective customer so as to gain his attention and interest, this forming the "approach."
f. Statements of the best methods of marshalling the talking points together so that a demonstration of the product's merits may be made to the customer—this forming the "demonstration and argument."
g. A thorough and complete analysis of the best "closing arguments" and discussion of various ways to "get the order signed."
h. A full list of the most common objections to making a purchase and ways of meeting these objections. After this plan is worked out, it will astonish many to note how simply the objections to purchasing on the part of prospective customers can be classified. It will also astonish the average sales manager to note how many different and excellent answers can be made to these objections by taking the answers to these by many managers and salesmen in different parts of the country. Whenever a salesman meets with some new form of rebuff, arguments to meet a new condition can quickly be secured by referring the question to the different managers for settlement in their weekly demonstration meetings.
i. Much space may well be given to a thorough and logical explanation of best methods of raising a customer desiring a low-priced product to one of higher price, "Raising him up the line," as it is called. Really scientific work can be done along this line. Methods of handling second-hand sales and exchange sales should also be treated fully.

It will be noted that almost all of these invaluable data can be secured from the salesmen's demonstration meeting reports.

After the selection of the instructor and preparation of the manual the balance of the work is largely routine.

First, each man—new or old— must be made to learn the manual "backward and forward." No halfway learning can be tolerated. He should then be thoroughly drilled in the "approach," "demonstration" and "closing" arguments under differing conditions along the lines noted in the Programme of Salesmen's Demonstration Meetings. He should be compelled to go through these in the regular

demonstration meetings before the entire body of salesmen. This process will require from two to six weeks depending upon the man and the character of the business. He is then started out in a territory and carefully watched. It is well also at times to have him attempt to make a sale at the office so that his methods may be noted. After about a week of this experience the instructor should accompany him on his regular rounds so as to note his methods. Failure to attend to important points may thus be observed. The instructor should then illustrate the proper methods by taking the selling end himself with several prospective customers and closing the sales. After the salesman has been in his territory for a full month the instructor should spend another period with him.

After these men are distributed to different territories the local manager should give them the same attention.

The instructor should visit the several territories from time to time and note closely the salesmen's method of demonstration, both in the weekly salesmen's meeting and before their customers. A constant and close study of weekly sales reports, supplemented by the reports of the weekly demonstration meeting, will clearly indicate the weak spots needing attention.

The local managers should from time to time be called into the home office for conventions. These can be made exceedingly helpful to both company and managers. They are the backbone of the selling division and they cannot be watched, trained, inspired, and worked with too much. Not only must they be driven on the question of sales, but they must also be held responsible for economy in management.

The devising of proper sales systems is a subject in itself that cannot be fully treated here.

It is essential though that mention be made of the two forms from which spring many branches of the system, namely, the Salesman's Daily Reports. One covers sales made and gives the important details as to the customer and his business; the other covers cases of failure

and gives the reasons for non-success. The two forms are shown below:—

SALESMAN'S DAILY REPORT OF SALES.

Name of Customer.....Rating.....Date.....
Character of business and system used.....
What Sold.....Date Delivery.....
Higher Priced Machine needed.....(Date).....
Duplicate Machine needed.....(Date).....
Send advertising matter as follows:.....

SALESMAN'S DAILY REPORT OF FAILURE.

Name of Customer.....Rating.....Date.....
Character of business and system used.....
What needed?.....Why not sold?.....
.....Date to return.....
Send advertising matter as follows:.....

Couple these two reports with a comprehensive list of prospective customers, and you have the best foundation for a comprehensive and valuable sales system. Many other forms will naturally be added to these and many different methods used for properly tracing up "prospective customers" noted from these reports.

Through your prospective customer list, coupled with the salesman's daily reports, you can determine whether or not each man is properly covering his territory. If he is not, you can make him do so. The daily reports data enable you to classify these prospective customers so that you may be sure that they receive the proper attention at the proper time and the proper kind of advertising matter pending the next visit of the salesman. These reports are capable of indefinite amplification along lines which will be of immense benefit to the business, especially when used in connection with a sales system along the lines described. Such systems will admirably supplement the factory methods advocated in preceding papers, and will serve to unify the

entire plan of organization, business, and method along such logical lines that there can be but one result—Progress!

A selling department built up along such lines is the best guarantee of high prices and good profits—a bulwark of strength against competition, and the strongest possible business foundation, especially in times of industrial depression.

Chapter XIV.

EFFECTIVE ORGANIZATION IN THE EXECUTIVE MANAGEMENT.

THE preceding chapters have dealt somewhat fully with the defects existing in the average manufacturing concern as regards its organization and its selling and factory methods and systems, and have indicated some methods of overcoming these troubles that have been found effective in everyday practice in the upbuilding of run-down concerns.

This discussion would not be complete unless the executive division, whether it consists of one man or twenty, were given some treatment. For indeed the troubles—the defects, both in organization and methods, that may be met with in selling force or factory—exist in particular strength in many an executive division, and cause infinite trouble. The small jealousy that impels one man or one group of men to underrate the value of work done by others, the lack of unity of purpose which often leads one set of men to block surreptitiously the good work of another group, often works incalculable loss.

The larger and more complex the executive end of a business, the more important does it become that great care be used in organizing it in such a manner that each member of this group shall be allowed to do his own work without interference from others, and yet, at the same time, that each member shall bring to the business and to the most serious problems in the business his best judgment on the business as a whole, and pour into a common reservoir his reason for objection, his particular plan, his best thought, his enthusiasm, his best self, for "the good of the business."

As long as the executive force work in unison, the balance of

the organization will generally do likewise. Let there be discord and lack of harmony amongst the heads of the business, and there will be an instant lining up of forces in opposition one to the other from one end of the working body to the other. This lack of harmony in the executive division arises for reasons similar to those that disintegrate the balance of the organization and cause it to lose so much of its latent power. The only cure, in my opinion, is the old one of "getting together." The general ideas already expressed in earlier chapters of this book relative to the formation of committees are particularly applicable here.

It is my intention to illustrate briefly the work of a group of executives, showing how the work of each one is related to and interlaced with the work of all. Before doing so, however, it is advisable to consider a few suggestive forms of reports from different sections of the organization which are very necessary in order that a full grasp upon the business may be held by those managing it. Of course no attempt to outline fully any system of reports generally applicable could be successful. The general forms of the ones suggested, however, are adaptable to many differing conditions.

Executive Reports from Selling Division.

As a fundamental form of report invariably necessary I submit one which shows how much business *must be done* in each line of product and in each territory. This must show the volume of sales required in detail. As against this there must be set the allowable factory costs, together with allowable costs of extras of all character. In addition to this, there must be carefully calculated out the allowable selling expense, including all items, such as salesmen's and managers' salaries, commissions, traveling expenses, advertising, etc. There must further be shown the allowable general expense, such as rent, insurance, taxes, telephone, telegraph, office salaries, etc. In all cases allowable percentages should be carefully worked out.

The "allowable amounts" must be calculated from close knowl-

edge, first, of how much profit the concern should make; second, of how much profit should come from each territory considering the possibilities of the business and expense of conducting it. When these computations are made for each territory, covering selling prices, factory costs, selling and general expenses, together with percentage

	%	N. Y. Branch.	%	Phila. Branch.	Etc.	
Required Sales. Amounts (Classified).						
Factory Costs. Amounts (Classified)						
All other Cost Items Classified						
Gross Profits						
Selling Expenses (Classified).						
(a) Salesmen, salaries....						
(b) " commissions						
(c) " expenses ...						
(d) Mngrs., salaries.....						
(e) " expenses						
(f) Advertising.....						
Total Selling Expense						
General Expenses (Classified)						
(a) Rent, Insurance, Taxes						
(b) Office Salaries						
(c) Telegraph and telephone						
(d) Miscellaneous..						
(e) Legal, etc						
Total General Expense						
Total All Expense						
Net Profit Required...						

STANDARD SELLING RECORD.

This Record is used, first, for showing required sales and allowable expenses with percentages; second, for showing actual sales made and actual expenses incurred and percentages. The use of the same form facilitates comparisons.

calculations, showing the proper relationship of all of these items, you have a solid foundation upon which to work and from which to drive for business. Of course this should be carried much further within the selling division. Each salesman should have his record to strive for. His showing should be based upon the same idea.

Having these data, the next step naturally is to supply the exact information as to sales record and expenses. The sales record, as far as the selling division is concerned, should, of course, be made up daily, the expense items being roughly calculated upon a percentage basis. The monthly sales record should, however, be complete. It should follow exactly the lines of the standard selling record shown opposite, the sales data being taken from the sales records, the expense data directly from the accounting department. This leaves in the mind of each manager of a selling division no iota of doubt as to what *must* be done, and by comparison he sees how much he has gained or how far he has fallen behind. Such reports provide the executives with accurate and usually much needed indices of sales conditions. They are especially valuable where the business done is in the nature of long-time contracts under which deliveries are made for long periods after the actual sales are recorded.

Other selling-division reports, such as those showing the distribution of sales, the covering of territories, the development of the selling efficiency of the organization, etc., and the condition of competition, would naturally be made and need no discussion here.

Factory Reports.

In preceding chapters and in my articles published in The Engineering Magazine in 1902 the question of factory reports has been quite fully dealt with. From the data secured through the suggested methods many interesting and important reports are derived. These are:

1. Factory Output and Efficiency Report.—This report may be adapted to meet the requirements of departmental efficiency reports

Week Ending	No. employees	Output		Hours Worked		PAY ROLL					Material Purchased		Inventory	Miscel. Charges	Factory Balances	Costs				Increases or Decreases	
		No. of Machines	Values	Total	Over-Time	Labor Direct	Piece Work	Day Work	Indirect	% Jobs reaching Standard Time	Direct	Indirect	(Subject to proper classification.)	(classified)	(classified)	Material	Labor (classified)	General Wages	Total	Where?	Why?

FACTORY EFFICIENCY AND OUTPUT REPORT.

Compare weekly or monthly results with averages of a preceding period of six months.

DATE.....

Name and Location of Customer.	Description of Order (Briefly)	Factory Order No.	Date of Order	Must Erect by	Must Ship by	What is Shipped	Condition of Orders (Classified)			
							Drawings % Done	Material % Received	In these columns place the different classifications of each contract, showing % finished	General

Signed—Committee (by Sec'y).

FACTORY PROGRESS REPORT (WEEKLY).

also. It should compare the results for various periods with the results of like previous periods, either as a total or an average. By noting the number of employees, pay rolls, and material purchases, and comparing the figures with values of output and inventories, a very accurate idea may be secured as to the relative efficiency of the entire shop or any department.

2. Progress-of-Work Report.—To every executive managing any shop, and particularly those working upon long-time delivery contracts a weekly progress-of-work report will prove invaluable. If this report were to be made up from the cost records, the task would be a great one. It can be handled very easily and simply, however, by the committees. Each foreman should have a keen knowledge of the progress of his portion of any job. These men, together with a bright secretary, in one of their regular meetings can easily and quickly formulate such a progress-of-work report as suggested. The advantages of such reports are many.

First, they provide an alert executive with a most important index as to progress of work and enable him to "pound the shop" for any work that he can note is falling behind.

Second, they force upon the attention of the foreman individually the progress of each job in his own department. They *compel* him to accumulate a very useful knowledge of his own work—oftentimes lacking.

Third, they place the factory in possession of data making it possible to give the selling department delivery dates which can be met.

Fourth, they are an invaluable aid to the treasurer, enabling him to predict with some degree of certainty when his collections will come due. Especially valuable are they in cases of large contracts calling for partial payments as work progresses.

Such reports, covering a very wide variety of work, have for a long time been made out by our factories on Saturday morning, arriving on my desk the following Monday. Meetings with interested heads of financial and sales divisions immediately follow, and as a

DATES.....FROM.....TO.....

	New York Branch.	%	Philadelphia Branch.	%	And all other Selling Divisions.
Deliveries (Classified).					
Total Deliveries.....					
Factory Costs (Classified).					
Total Factory Costs.....					
All other Cost Charges (Classified), *e. g.*, Delivery—Finishing.					
Total All Other Costs.....					
Total Delivered Costs.....					
Gross Profit.....					
Deduct Selling Expense (Classified).					
Salesmen, salaries and commissions.....					
(Depmts.) (a).....					
(b).....					
(c).....					
Salesmen, expenses.....					
(Depmts.) (a).....					
(b).....					
(c).....					
Mngrs., salaries.....					
" expenses.....					
Advertising.....					
Total Selling Expense.....					
General Expenses (Classified).					
Office Salaries.....					
Rent, Insurance and Taxes...					
Telegrams, Postage, etc.....					
Stationery and Printing.....					
Light, Heat and Power.....					
Maintenance.....					
Adjustments and Losses.....					
Legal.....					
Miscellaneous.....					
Total General Expense.....					
Total Selling and General Expense.....					
Profit (black). Loss (red)					

EXECUTIVE PROFIT AND LOSS REPORT.

result there exists the closest possible touch between the several divisions upon the one important point—Production.

Executive Report.

The report of paramount importance is the one illustrated on the preceding page. It should be produced monthly from the books of the concern. The several divisions are self-explanatory.

Comparing this with the selling-division reports, there is provided a full index of business conditions. Couple it with factory reports already mentioned, and a monthly balance sheet follows.

Having now described in a general manner the detail, I can perhaps best illustrate the value of the methods advocated by quoting a programme of action taken "from actual life" by a committee of executives of a very large concern. The committee is formed of the president, the general manager, the treasurer, the sales manager, and the factory manager. The understanding is general that heads of departments shall frequently be called into their conferences. A typical programme is as follows:—

President; acts as chairman.

General Manager.—Critical discussion of business conditions, with especial reference to those sections in which the records show a decided falling off in business. Discussion with sales manager as to the reasons for this condition. Discussion develops that a new form of competition has arisen in that particular region. Steps are taken immediately to meet this before it grows to greater strength.

General discussion of executive report. An analysis shows where the greatest profits in the business lay and where the greatest losses occurred. Discussion of expense items shown on executive report.

Sales Manager.—(a) Reports on sales conditions in various territories and orders coming therefrom.

(b) Competition; what must be done in way of new methods or new product to meet it.

(c) Progress of training department.

(d) Expense.

Factory Manager.—(a) Discussion of factory output and efficiency.

(b) The progress-of-work report.

(c) Report on progress of new factory methods and inventions.

Treasurer.—A discussion of financial outlook with especial reference to the future deliveries as outlined on progress-of-work report.

In this concern, formerly handicapped severely by a lack of knowledge of such important points, a revolution was worked through the adoption of the simple and direct system.

And so I maintain that the adoption of these simple and natural methods will change an organization burdened with jealousies, handicapped by misunderstanding, held back by lack of knowledge, lack of progress and general inefficiency, to one comparatively free from personal enmities, led by a sense of certitude as to actual condition in field and factory; constantly impelled, even in the smallest details, toward a greater degree of efficiency and surcharged with the feeling of true enthusiasm—the will to work "for the good of the company."

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